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The Physiology of Digestion in the Ruminant*

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Bacteria are the important agents in digestion in the ruminant and the stomach of the ruminant has become adapted to provide conditions favourable for bacterial activity. The efficiency of the rumen in this respect is brought home in no uncertain way when attempts are made to imitate the conditions present *in vitro*, for the technical difficulties involved are considerable. The conditions present are as follows: (1) food enters the rumen at intervals throughout the day; (2) the material in the rumen is continuously mixed by movements of the reticulum and rumen; (3) digesta pass from the rumen, as far as one knows, continuously throughout the 24 hours; (4) the material in the rumen is kept in a moist condition by the inflow of saliva, which again is continuous within limits throughout the 24 hours and which assists in maintaining the *p*H of the digesta relatively stable; (5) the digesta are maintained under anaerobic conditions; (6) products of fermentation are removed continuously from the rumen.

The most noticeable feature of digestion in the rumen is its perpetual progression, for once an animal has been weaned it remains for the rest of its life, unless it fasts for a few days, in a state of active digestion, the greater part of which apparently goes on in the stomach. This is in direct contrast to carnivorous animals, which eat and digest highly nutritious and concentrated protein and whose digestive process in the stomach is over in three or four hours. The nature of the foodstuffs eaten by the ruminant, together with the time taken for bacteria to ferment such resistant substances as cellulose, necessitate slow digestion; time is important to the ruminant and, to allow sufficient time and sufficient space for the digestion of fibrous and bulky foodstuffs, a fermentation vat is necessary and this is provided by the reticulum and rumen together. The continuity of bacterial digestion is essential if the bacteria themselves are to survive in sufficient numbers to provide an active culture.

The conditions present in the stomach of the adult ruminant, however, are different from those present in the newly born animal. In the latter, milk is the sole source of nourishment, at any rate for the first week of life, and milk cannot be digested in the normal manner in the rumen as this organ is aglandular; consequently the mechanism concerned with the transport of milk through the stomach is important.

THE OESOPHAGEAL GROOVE

When a lamb or calf suckles milk, the milk passes directly to the abomasum. Direct passage is accomplished by a structure known as the oesophageal groove, consisting of two muscular lips, which, when contracted, form a gutter or partially closed tube running from the opening of the oesophagus to the omasum.

The factors influencing the closure of the oesophageal groove have received much attention. Wester (1930) was the first to describe its action and he came to the conclusion that closure of the groove was due to reflex action and that the presence of milk in the mouth stimulated the reflex on account of its chemical composition. Further work, Schalk and Amadon (1928), Wise and Anderson (1939), emphasized the fact that the manner in which the animal ingested milk had an influence on its subsequent destination. Both showed that suckling produced an almost complete passage of milk to the abomasum but that variable amounts of milk escaped into the reticulum and rumen when calves drank milk from a bucket. Wise and Anderson (1939) also proved that the chemical composition of the milk was not the only factor concerned in the closure of the groove, for water passed to the abomasum in calves, when it was suckled, to almost the same extent as milk, but when water was drunk from a bucket then the bulk of it passed to the reticulum and rumen. On the other hand, most of the milk drunk from a bucket passed in the majority of cases to the abomasum; the quantity of milk, which passed to the reticulum and rumen, varied with different animals.

Watson (1944) considers that the most important factor associated with the passage of fluid to the abomasum is the desire, as judged by its behaviour, an animal exhibits for milk. He made a detailed analysis of the four factors, drinking, suckling, milk and water, in sheep and found that, irrespective of which of the two opposed factors were combined, the fluid ingested passed to the abomasum, for the most part, if the animal was accustomed to taking milk in the manner in which the fluid was given. In contrast, if milk or water were given in the manner in which the animal was accustomed to take water in order to quench its thirst, then the fluid passed mainly to the reticulum and rumen.

The inference from these experiments is that higher centres are involved and that closure of the groove is not a simple reflex, at least as far as milk is concerned. The fact that Wise and Anderson (1939) found that in the same calves water drunk from a pail passed to the reticulum and rumen, while milk from a pail passed to the abomasum, infers that no broad generalization is possible. Watson's results suggest that the deciding factor is whether the animal understands that it is taking milk or water. The factors which impress such an understanding on the animal need further clarification and it is possible that smell and taste are also important as well as the manner in which the fluid is presented to the animal. It is well known that the groove can be stimulated to close by introducing 5 per cent. copper sulphate into the mouth, which suggests that abuse of the gustatory sense organs can initiate closure of the groove; but even here closure of the groove is not due only to the presence of copper sulphate in the mouth, for mechanical stimulation of the buccal mucosa by the manipulations involved in drenching, Watson (1944), is sufficient in itself to produce closure of the groove in some animals.

FACTORS CONCERNED IN MAINTAINING CONSTANT CONDITIONS IN THE RUMEN IN THE ADULT

1. *The Entrance of Food into the Rumen.*—When the animal is weaned, food and water pass to the reticulum and rumen and direct passage to the omasum and abomasum rarely occurs, under normal circumstances; even material that is swallowed after regurgitation and remastication again enters the reticulum and rumen.

2. *The Movement of the Reticulo-Rumen Sac.*—Food in the rumen is kept continually in motion by movements of the reticulo-rumen sac—the reticulum and rumen are best considered as one organ—and the cycle of contraction starts in the reticulum, which contracts approximately once a minute and its movement is brisk and in two stages. The level of the liquid contents contained in it is raised as the organ contracts and the anterior and dorsal sacs of the rumen are thus flooded. Relaxation of the rumen occurs immediately after the height of contraction and liquid material in the anterior part of the rumen runs back again into the reticulum. The whole movement from start to finish occupies about five seconds.

The dorsal sac, together with the anterior pillar of the rumen, commence to contract as the reticulum relaxes. The movement is slow and sustained compared with that of the reticulum. The material in the dorsal sac is compressed and liquid tends to be squeezed toward the ventral sac. As the dorsal sac relaxes, the ventral sac contracts and elevates the digesta contained in it, which is more liquid than that in the dorsal sac, in an upwards and forwards direction. Finally the ventral sac comes to rest and the cycle of contraction in the whole organ is complete. Variations of this rhythm occur, but all are based on the movements described.

The movements of digesta through the reticulo-rumen sac are determined to some extent by the specific gravity of the food. Light materials such as hay pass from the cardia backwards to the rumen, aided by the flow of liquid every time the reticulum contracts. Heavy materials such as grains, meals, etc. (and foreign bodies) tend to sink into the reticulum; even so the greater part of the concentrates of a ration can be found in the rumen.

The rumen becomes filled with a mass of material and in the early stages of digestion the material in the dorsal is more solid than in the ventral sac. The mass of digesta is flushed with liquid contents every time the reticulum contracts and as the liquid returns to the reticulum, small particles of food pass back with it. In addition, the elevation of liquid in the ventral sac flushes material in the dorsal sac. As digestion proceeds and the solid material disintegrates, the digesta becomes similar in consistency throughout the rumen and is best described as a thick gruel. If no further food is given, the contents of the rumen become more and more liquid. During rumination, material is regurgitated from the anterior region of the reticulo-rumen sac and consists of the thick gruel-like digesta. It is improbable that recently ingested fibrous material is regurgitated

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until it has undergone considerable disintegration. The mechanism of regurgitation is well known and needs no further discussion here.

3. *Passage of Digesta from the Reticulo-Rumen Sac.*—Only material in the reticulum can pass to the omasum. Heavy foods, which may pass directly to the reticulum when swallowed, can pass directly to the omasum (Schalk and Amadon, 1928), but all such food does not take this direct route; in fact Nevens (1928) found that the bulk of a feed of whole maize could be recovered from the rumen of cattle eight hours after feeding.

The mechanism governing the movement of digesta from the reticulum is not understood. Wester (1926) and Schalk and Amadon (1928) consider that a sudden relaxation of the omasum, with an accompanying fall of pressure in that organ, draws material from the reticulum, but this explanation is not generally accepted. As the omasum, abomasum and intestines always contain digesta, one must assume that the passage of material from the reticulum to the omasum onwards is continuous throughout the 24 hours.

4. *The Saliva and the Reaction of the Digesta in the Rumen.*—The flow from the parotid gland is continuous and copious. Colin (1886) estimated that the total quantity of saliva secreted by the cow in 24 hours was approximately 60 litres. The saliva from the parotid glands is alkaline and it forms an efficient buffer, owing to the fact that it contains large quantities of carbon dioxide in both the free and combined states. It is in fact a bicarbonate buffer and the quantity of carbon dioxide present is far greater than that present in the plasma. The other constituent of the saliva, which is high compared to that of the plasma, is phosphorus which is eight or nine times the quantity found in the plasma (MacDougall, 1945).

Hastings (1944) has pointed out that the food of the ruminant contains a greater proportion of carbohydrate, from which acids are formed by bacteria, than proteins, from which alkaline substances are formed. In consequence of this, the fermenting material in the rumen becomes acid. The importance of the alkaline saliva is thus obvious, for if the reaction of the fermenting material became too acid, the further growth of bacteria would be impossible, as in fact happens in silage, and digestion would be arrested.

The saliva is not the only means by which the reaction of the rumen contents is maintained within the range of approximately 5·8 to 7·5. As fermentation increases after feeding, the amount of free acid present rises in relation to combined acid; but as free acid is absorbed from the rumen more rapidly than combined acid, this in itself helps to prevent the reaction from becoming too acid. (Danielli, Hitchcock, Marshall and Phillipson, 1945).

5. *The Gases of the Rumen.*—The gases present in the rumen are principally methane and carbon dioxide, but traces of other gases are often found. Average figures given by Kleiber (1945) for cows feeding on alfalfa are as follows:—

67 per cent. CO_2, 26 per cent. CH_4, 7 per cent. N_2, 0·1 per cent. H_2S and less than 1 per cent. O_2,

which agree closely with those found by earlier workers. Washburn and Brodie (1937) found that, as digestion proceeded, the percentage of nitrogen and oxygen rose, but that the ratio of these two elements was greater than that of atmospheric air, in agreement with the figures given above. It is probable that the presence of these two gases is due to atmospheric air entering the rumen from the oesophagus, but the reason for the alteration in the proportion of one to the other is not known. It may be that oxygen is used by aerobic bacteria at the surface of the digesta or oxygen may diffuse through the walls of the rumen at a greater rate than nitrogen. The main point to be made here, however, is that the quantity of oxygen present is negligible and at the most can only be available to an insignificantly small number of the bacteria in the rumen. Quin (1943b) has suggested that when sheep eat large quantities of fresh green succulent material, such as green lucerne, sufficient air is swallowed with the material ingested to render the conditions inside the rumen aerobic. Until this has experimental support, it must be accepted with reserve.

6. *Removal of the Products of Fermentation.*—The products of digestion in the rumen can be removed by four routes:—

(*a*) Utilized by bacteria and other organisms.
(*b*) Regurgitated.
(*c*) Passed on to the omasum and abomasum.
(*d*) Directly absorbed.

(*a*) If we take the first possibility, it is not true to say that any product of bacterial digestion in the rumen can be considered to be a final product of digestion only if it is absorbed or eliminated from the rumen unchanged, for this conception rules out the possibility of both processes occurring and is not valid. Any material found in the rumen may pass to the abomasum even if only in small traces; similarly, the possibility of absorption cannot be ruled out if the material is soluble. Lactic acid is a notable example. It is found in the rumen, particularly when foods rich in soluble sugars are fed, *e.g.*, mangold wurzels, and, although it is an intermediary stage in the production of volatile acid, some may appear in the abomasum (Phillipson and McAnally, 1942) and the possibility of its direct absorption, although not proved, must be considered. Similarly, the carbon dioxide in the rumen, part of which is undoubtedly of salivary origin, may provide the carbon from which methane is produced, the hydrogen being obtained from fatty acid. This infers that fatty acids, which are found in quantity in the rumen, are themselves unstable, yet they are absorbed directly into the blood stream. The expression "final end product of digestion" can be applied to the rumen only in a relative way.

(*b*) Loss by regurgitation refers only to the regurgitation of gas. The factors controlling the regurgitation of gases are important when discussing such subjects as bloat.

(*c*) The material passed to the omasum presumably consists of a representative sample of the contents of the reticulum at any given time and, owing to the continual movement of fluid between the reticulum and rumen, the fluid in both organs again is much the same; it is in the quantity of dry matter present that differences occur. The materials leaving the reticulum therefore consist of a solution of organic acids, in combination with bases provided by the saliva and the food, together with bacteria, protozoa and solid matter in suspension.

(*d*) It was mentioned before that direct absorption of free acid from the rumen occurred at a greater rate than the absorption of combined acid. The fact that absorption from the rumen was possible was first demonstrated by Trautmann and Schmitt (1933), who showed the epithelium of the rumen to be permeable to the alkaloids pilocarpine and atropine. Absorption of volatile acid was first suspected when it was found that the concentration of volatile acid in the rumen was much greater than that in the abomasum and that the introduction of sodium acetate into the rumen produced no increase in the abomasum, although the concentration in the rumen returned to normal in a few hours (Phillipson and McAnally, 1942). Further work revealed that the concentration of volatile acid in the blood draining the rumen and reticulum was much higher than that in the peripheral blood. Blood drawn from the various veins, draining the remainder of the alimentary tract, showed that volatile acid was also absorbed from the abomasum and caecum, but to a less extent than from the rumen, while the quantity recovered from the blood coming from the abomasum and small intestine was negligible (Barcroft, McAnally and Phillipson, 1944a).

Rapid absorption of free acid was found to occur from the rumen after it was emptied and washed clean and the entrance and exit closed by ligatures. Thus the rate of absorption of individual acids from a mixture of acetic, propionic, and butyric acids in known proportions, was determined first at a *p*H of 7 and then at a *p*H of 5·8. The *p*H was reduced by adding known volumes of normal acetic acid to the rumen contents. In order to maintain the *p*H at this lower level, further additions of normal acetic acid were necessary at frequent intervals, for unless this was done the *p*H rose. The rate at which the combined acids left the rumen at *p*H 7 was consistent with the supposition that they passed through the intercellular spaces by diffusion. The rate at which free acid left the rumen, however, was too great to be accounted for by diffusion alone, but was also explicable on the assumption that it left the rumen both by diffusion through the intercellular spaces and also by permeation of the fatty layer of the epithelial cells themselves. As free acid was absorbed at a greater rate than combined acid, the *p*H inevitably moved towards neutrality, even though no saliva could enter the rumen (Danielli, Hitchcock, Marshall and Phillipson, 1945).

As fatty acid can be absorbed, there is reason to suppose that anything in solution, provided its molecular weight is not too large, can be directly absorbed. Indeed, a molecule as large as sodium ortho-iodo-hippurate has been proved to be able to pass into the blood stream from the rumen (Barcroft, McAnally and Phillipson, 1944b).

The products of digestion in the rumen can therefore become available to the animal either by passage to the abomasum and small intestine, where further digestion can occur, or by direct absorption.

The Micro Fauna and Flora of the Rumen

Many types of organism have been observed and described in the rumen, but only those which have had sufficient attention paid to them to give some indication of the part they play in digestion will be considered here.

1. Ciliated protozoa which are indigenous to the rumen.
2. A pseudo yeast described by Quin (1944).
3. Iodophilic bacteria described by Baker (1939, 1942) and Van der Wath (1942).
4. Propionic acid bacteria described by Elsden (1945).

Of these only the propionic acid bacteria have been isolated in pure culture.

1. *The Protozoa.*—Young suckling ruminants do not harbour ciliates, and these organisms appear when the animal eats substantial amounts of solid food. This fact was originally taken to mean that resistant forms were ingested with the food, but this view has not been confirmed; for both Becker and Hsuing (1929) and Mangold

and Radeff (1930) found that both goats and sheep, in which the protozoa had been removed by fasting and dosing with 2 per cent. copper sulphate, remained free of protozoa, provided they were strictly isolated, even though they were fed unsterilized food including hay. Ciliates only appeared again in the rumen when the animals were placed in contact with normal stock. It was concluded that infestation occurred by animals feeding at the same manger and drinking from the same trough; for ciliates were demonstrated in the saliva taken from the mouth of normal animals and presumably, every time an animal ruminates, its mouth becomes flooded with protozoa contained in the material regurgitated. Similar experiments in Russia (Winogradow *et al.*, 1930) were not so conclusive as those just quoted, but both Becker (1932) and Mangold (1933) consider that the result is due to insufficient care in isolating the animals. It is well known that the protozoa of the rumen survive for only short periods outside the rumen and are susceptible to cold and desiccation. Only one unsubstantiated claim has been made that viable protozoa from the rumen can be found on grass (Fantham, 1922), although many others have searched for resistant forms in faeces and fodder.

The numbers of protozoa present in the contents of the rumen vary with diet. Mowry and Becker (1930) found, when hay was fed alone, they were in the region of 200,000 per ml. Addition of starch to the diet caused an increase to 700,000 per ml., while addition of protein raised the numbers to 2,000,000 per ml. Similar results were obtained by Van der Wath (1942), who found that sheep fed on wheat straw alone harboured 50,000 ciliates per ml. The addition of maize meal to the straw produced a sharp increase in the numbers present, which rose to the region of 500,000 per ml. Diets of maize and lucerne hay produced a population of between 1,400,000 and 2,600,000 per ml. Seasonal fluctuation, in sheep grazing freely, was also noted and this was correlated with the amount of dry matter consumed, the percentage of nitrogen present and the digestibility of both nitrogen and dry matter. The numbers present were least in July (mid-winter in South Africa) and greatest in January, the two extremes, on average figures, being 98,000 per ml. in winter and 455,000 per ml. in summer. It is clear that the numbers of ciliates present depend on the food available for them in the rumen. Coarse fibrous food does not support a large population; but starch and also protein allow a much higher rate of multiplication.

It is easy to observe that the protozoa ingest starch grains; for, if a sample of rumen contents is drawn soon after the animal has eaten a meal containing starch, the majority of the ciliates, when stained with iodine, can be seen to contain blue granules. In the later stages of digestion, reddish brown stained granules are found, which suggests that the starch is laid down as glycogen within the protozoan. This will be referred to later.

The ciliates ingest particles of plant material and disintegration of its cellular tissues has been observed. As numerous bacteria are ingested as well, it was considered that the digestion observed was due to bacteria and not to enzymes produced by the protozoan itself. Recently, however, Hungate (1942-3) demonstrated that certain species of Diplodinia produce an enzyme which converts cellulose into a reducing sugar; this was not so in members of other genera present in the rumen. The possibility of some of the protozoa playing a more important part in the digestion of cellulose than is suggested by the work of Mangold and Becker, must be considered; for those protozoa which are capable of producing glucose from cellulose and living and multiplying on the energy so obtained, even if they ingest only small particles of food after considerable bacterial degradation has occurred, can convey to the host, when they are subsequently digested in the abomasum and small intestine, useful energy, that might otherwise have been lost.

2. *Pseudo Yeasts* (Schizosaccharomyces ovis; Quin, 1944).—These organisms were first investigated by Quin (1944), who noticed that they appeared in abundance in the digesta of the rumen of sheep, particularly of those fed on lucerne. They are oval organisms, staining yellow with iodine, or dark brown after the sheep has fed. They appear to produce two main products of digestion when glucose is present, namely, (1) gas, rapidly produced and (2) glycogen, deposited in their cytoplasm and giving a dark brown stain.

Quin attributes the occurrence of bloat in sheep fed on green lucerne to the presence of these organisms, which by *in vitro* tests were found to produce a much more rapid evolution of gas, in the presence of glucose, than the bacteria of the rumen.

3. *Iodophilic Bacteria.*—Baker (1943) has described several types of bacteria in the rumen of cattle as iodophilic since they stain blue with iodine. These organisms are similar to those previously described by Baker and Martin (1938, 1939) in the caecum of non-ruminating herbivorous animals. By the use of polarized light, he was able to demonstrate that certain of the organisms play a part in the disintegration of plant tissue, for iodophilic organisms cluster round the material and produce erosions in their immediate vicinity, provided the tissues are not heavily lignified. The organisms can be demonstrated inside the erosions produced, the contours of which correspond to the cell boundaries of the bacteria. Baker considers that the products liberated during the process of erosion are taken up by the bacteria and synthesized into bacterial starch, giving the blue staining reaction with iodine.

Van der Wath (1942) has made further studies on the organisms and has observed the disintegration of starch granules by the activity of iodophilic cocci; he has also photographic evidence that the disintegration of starch granules, within the protozoa of the rumen, is due to iodophilic bacteria ingested with the granules and that granules of glycogen, which are subsequently laid down in the cytoplasm of the protozoa, are iodophilic cocci, which in the later stages of digestion exhibit the dark brown reaction and not the blue reaction to iodine. Van der Wath also found that the addition of glucose and fructose produced an iodophilic reaction, particularly in cocci; disaccharides produced the same result, but not so rapidly, while starch and pectin produced a reaction that was still further delayed.

4. *Propionic Acid Bacteria.*—Elsden (1945) has isolated these from the rumen contents of the sheep. They are Gram-positive, catalase positive, anaerobic organisms, which grow on yeast water, containing 1 or 2 per cent. of lactate. These bacteria are looked upon as normal inhabitants of dairy products, into which they were thought to gain entrance from faeces or rennet, as they have been isolated from the faeces of cattle and the abomasum of calves. They were first recognized as the organisms responsible for the fermentation of Gruyère cheese. Their classical biochemical activity is that they ferment three molecules of lactic acid, with the production of two molecules of propionic acid and one molecule of acetic acid, together with carbon dioxide. Evidence, suggesting that they are numerically significant in the rumen, was produced by Elsden, who showed that glucose, when fermented by mixed cultures from the rumen of sheep, *in vitro*, produced equal quantities of propionic and acetic acids. Similarly, if glucose is placed in the rumen of sheep with a rumen fistula, the increase in fatty acid is principally due to propionic and acetic acids, the proportions of which become much nearer together than is usually the case in the rumen.

Products of Digestion in the Rumen

The known products of digestion, and digestion is here taken to include synthesis as well as the production of smaller molecules, are as follows: (1) Gas, principally methane and carbon dioxide. (2) The lower fatty acids, acetic, propionic and butyric. (3) Bacterial starch, glycogen and vitamins of the B complex, together with the micro-organisms which synthesize these products.

1. *The Gases of the Rumen.*—The composition of the gases of the rumen has already been discussed. Ritzman and Benedict (1938) found that the average amount of methane, excreted by cattle, amounted to 9·6 per cent. of the total digestible energy of the ration; Bratzler and Forbes (1940) measured the quantity of methane produced against the amount of carbohydrate digested, on a gramme for gramme basis, and found that from 4 per cent. to 5 per cent. of the digestible carbohydrate appeared as methane; the lower proportion occurring with the greater quantity of carbohydrate digested. Methane seems to be entirely a waste product and needs no further consideration.

2. *The Lower Fatty Acids.*—Woodman and Evans (1938) demonstrated that fermentation of cellulose, by mixed cultures from the rumen, produced a mixture of lower fatty acids with production of gas. The fermentations appeared to pass through the stages of cellulose, cellobiose, glucose, pyruvate, lactate and fatty acid (Woodman and Evans, 1938). They came to the conclusion, on insufficient chemical evidence, that the end products of fermentation were acetic and butyric acids. The variations in the volatile fatty acid content in the rumen contents of sheep, with a permanent fistula, was investigated by Phillipson (1942) and it was found that the concentration increased after feeding and that the rate and degree of concentration depended on the diet; thus a diet containing mangolds produced a rapid increase in concentration, while a diet containing starch produced a slow rise that was sustained over a long period. Hay, on the other hand, produced a slow, but prolonged rise and the increase in concentration was small, compared to that obtained on the previous diets. The amounts of volatile acid present were consistently higher in sheep grazing young summer grass, than when they were on the stall diets mentioned. The *p*H of the digesta reflected the change in concentration of volatile acid in a reciprocal direction; thus it was consistently lower in sheep, which were grazing, than in animals which were stall fed. The results are summarized as follows:—

Diet	Average Variation of *p*H	Variation of Volatile Acid Content ml. 0·1 *N* per cent.
Bran, oats and chaffed hay ...	5·96–6·99	64·8–119·1
Mangolds, cabbage, bran, oats and chaffed hay	6·20–7·03	61·6–118·6
Hay	6·25–6·76	57·6–94·2
Pasture grass	5·80–6·39	118·7–162·3

The total quantity of volatile acid in the rumen and reticulum of ten sheep, taken from pasture, was estimated after death and the figures varied from 26·8 to 91·4 grammes volatile acid, expressed as grammes acetic acid, the average being 64·2 grammes (Marshall and Phillipson, 1945). The lower figures were obtained from animals killed in the middle of the night, when the total quantity of digesta, in two out of three cases, was small.

The concentration of volatile acids throughout the alimentary tract, when expressed as grammes acetic acid per 100 grammes dry matter, is greatest in the rumen and reticulum, where it is in the region of from 6 per cent. to 9 per cent.; in the omasum it is lower and in the abomasum it is 1 per cent. or less. The concentration does not rise again until the caecum, when the figure is once more in the region of 5 per cent.

Elsden (1945), using the partition chromatogram, showed that the acids present are acetic, propionic and butyric and that acetic acid predominates, being approximately 65 per cent. of the total fatty acid present.

3. *Multiplication of Micro-organisms and Synthesis of Starch, Glycogen and Vitamins of the B Complex.*—The increase in the products of digestion, such as fatty acid and methane, is a direct indication that active proliferation of the organisms concerned is occurring; if this were not so, no increase in the chemical products could occur. During this active phase of growth, certain of the micro-organisms of the rumen synthesize, within their cytoplasm, bacterial starch or glycogen. The extent of active growth, however, is controlled, not only by the available sources of energy, but also by the amount of nitrogen present in the food. Thus, if insufficient nitrogen in an acceptable form is supplied by the diet, digestion in the rumen cannot be as extensive as if the requisite amount were present. Van der Wath (1942) investigated the numbers of bacteria present in the rumen on various diets. Wheat straw, alone, supported a bacterial population that was below normal levels; the addition of dextrinized starch to the diet produced no significant increase, but urea, added to the ration in addition to starch, increased the bacterial count by 74 per cent. When the urea was substituted by white fish meal, the bacterial population increased by 206 per cent. Wheat straw and dextrinized starch contain very little nitrogen and so the diet, although including sufficient carbohydrate, did not support a numerically normal flora. The addition of nitrogen, in the form of urea, produced an increase, but, even so, the population remained below normal, until protein was substituted for urea. In this case, therefore, nitrogen and the form in which it was given were limiting factors. In trials, in which nitrogen, in the form of meat meal, was given in excess, the bacterial population was depressed, even though sufficient carbohydrate was present. Similarly, excess carbohydrate, given as maize in an otherwise balanced ration, depressed the bacterial population. The inference is obvious: a balanced ration provides optimal conditions for bacterial growth.

The influence of minerals was also investigated and it was found that the addition of 10 grammes of bone meal to a diet of veld hay and dextrinized starch, produced an increase in the population of 26 per cent. A similar increase (32 per cent.) was obtained when bone meal was added to a diet of wheat straw and starch. In these cases it was most probably the phosphate constituent of bone meal that was the beneficial factor. Phosphorylization is an important mechanism in the synthesis and fermentation of carbohydrate and the need for phosphorus in the rumen is exemplified by the high concentration present in the parotid saliva.

In addition to the number of bacteria, the type of micro-organism is affected by the diet. Quin (1943) demonstrated that the yeast, *Schizosaccharomyces ovis*, is abundant in the rumen when lucerne is fed, but is barely evident when the diet consists of coarse hay. Fasting resulted in the rapid disappearance of yeasts from the rumen contents; when feeding was resumed after three days, an abundant iodophilic flora developed and yeasts made their appearance later and were fully established again after a period of 14 days. The number of iodophilic bacteria present diminished as the yeasts developed, so that they no longer dominated the picture. It appears that there is competition among organisms of the rumen for easily available carbohydrate; and it is probable that changes in the diet lead to adjustments in the relative proportions of organisms present.

Elsden (1945) found that practically no fermentation of glucose occurred in the rumen of a sheep fed on a diet of poor hay; after the diet was changed to clover hay, fermentation of glucose occurred, but the fermentation was slow and lactic acid persisted for many hours. Some weeks later, the fermentation, when tried, was complete and more rapid; the fatty acids, propionic and acetic, were produced and lactate did not persist in the rumen, indicating that the balance of the microflora concerned in the fermentation of glucose was changing with the diet; when fermentation was slow the microflora was characteristically iodophilic, when it became rapid pseudo-yeasts were predominant.

It was originally shown by Theiler *et al.* (1927) that cattle kept on a diet low in vitamin B failed to show symptoms of B deficiency; since then, McElroy and Goss (1940) have proved that members of the B complex are produced in the rumen, for they fed a cow on a diet, which was very low in members of the B complex, and found that the quantities of the individual members produced were greatly in excess of the amounts eaten with the food. Of the individual members, thiamine, riboflavin, nicotinic acid, pyridoxine, biotin, and pantothenic acid, have been shown to be synthesized. This work has been confirmed by many others (Goss, 1943).

The Value of the Products of Digestion

1. *The Lower Fatty Acids.*—The three acids produced, acetic, propionic and butyric, are present in sufficient quantity to make a substantial contribution to the energy requirements of the animal. The quantity absorbed from the rumen and reticulum alone was estimated to be from 1 to 5 grammes an hour, expressed as grammes acetic acid (Barcroft *et al.*, 1944a). In addition, lactic acid may be absorbed in significant amounts, even though it is not stable in the rumen; but there is as yet no experimental evidence on this point. There is no difficulty in explaining the nutritional value of lactic and propionic acids, as both can be converted into glycogen in the liver. Little, however, is known of the metabolism of acetic acid, which is produced in the greatest quantity. It seems to be metabolized, as little, if any, appears in the urine. It is destroyed if added to Ringer's fluid, perfusing the isolated beating rabbit's heart (Barcroft *et al.*, 1944c); it gives rise to acetoacetic acid if included in the fluid perfusing an isolated liver poor in glycogen, Maclean (1943). It has been shown that acetic acid in the form of the triglyceride can be substituted for an equivalent amount of glucose and glycerol in the diets of growing rats without impairing the growth curve (McManus *et al.*, 1943). Acetic acid cannot be ignored as a nutrient, although the use to which it is put in the body remains to be explained.

2. *Micro-organisms.*—The usefulness of micro-organisms depends upon whether they are digested in the abomasum and small intestine. On this point there is little direct evidence. Protozoa have been observed to be digested by pepsin (Baker, 1943). If, however, it is assumed that bacteria are digested, then they would presumably form a supply of protein of high biological value and the polysaccharides and vitamins contained in them would become available to the host. It is known that urea can be used as a protein supplement for cattle, if not more than one-third of the protein is so substituted, Goss (1943), and as growth and milk production are unaffected within the limits of individual variation, it is reasonable to assume that the bacteria, which proliferate on the nitrogen so provided, are digestible.

The important question to answer is this: how much protein and polysaccharide does the animal receive in microbiological form? It is incorrect to assume that the products of digestion in the rumen are wholly free chemical substances, such as fatty acid, which can be absorbed and used directly, or that the animal lives entirely on the organisms that grow in the rumen. The ruminant lives, not only on fatty acid and micro-organisms, but also on any food, starch, or protein, that leaves the rumen unaffected by the action of micro-organisms. The final answer must depend on quantitative measurements of the amount of these materials that becomes available to the animal. In this respect, an attempt has been made to estimate the amount of volatile acid absorbed. So far, it has proved impossible to measure quantitatively the amount of digesta leaving the rumen in 24 hours and, until this is done, no estimate can be made either of the quantity of microbiological protein or polysaccharides that become available to the animal, or of the quantity of foodstuffs that leave the rumen unchanged. The technical difficulties involved in making these measurements have not so far been overcome.

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Discussion

Mr. J. O. L. KING: He had thoroughly enjoyed listening to Dr. Phillipson's paper that afternoon, and members were very grateful to him for coming to speak to them. Dr. Phillipson was a recognized authority on this subject and had put forward many aspects for their consideration. It had been said that a reliable set of bowels was worth more to a man than any quantity of brains. This statement was hard to prove or disprove, and must remain a matter of opinion, but they would all agree with a similar statement applied to the domestic ruminant.

Dr. Phillipson had referred to the direct passage of milk from the mouth to the abomasum through the closed oesophogeal groove in the calf. As the course of drugs, whether passing direct to the abomasum or via the rumen and reticulum, markedly influenced their action, the artificial closure of this groove in older cattle was of interest. He was referring particularly to the administration of anthelmintics directed against parasites actually in the abomasum. There were, of course, considerable anatomical differences between the stomachs of calves and adults, for in the newborn calf the first three stomach compartments were small and the rumen and reticulum together were only half as large as the abomasum, whilst even at four months the rumen and reticulum were only four times as large as the omasum and abomasum together, compared with a one and a half year old animal in which the rumen provided 80 per cent., the reticulum 5 per cent., the omasum 7 per cent., and the abomasum 8 per cent. of the stomach capacity. It had been stated that if food and water were withheld for 40 hours before dosing, the drugs were more likely to enter the abomasum in concentrated solution. It had also been suggested that various chemical substances in solution, such as copper sulphate, to which Dr. Phillipson referred, and sodium salts, should be given immediately before the administration of anthelmintics to close the groove. Had Dr. Phillipson any information to give about this as a practical measure?

Dr. Phillipson had referred in two places to the formation of ruminal gases and their removal by belching, an important practical point as their accumulation led to tympany. It had been found experimentally that legumes and grasses each fermented at about the same rate to form approximately the same amount of gas, yet in practice the legumes caused tympany and the grasses did not. It seemed that there was some factor which interfered with belching when the rumen was filled with leguminous material. Dr. Phillipson had suggested that this might be the presence of a saponin which caused the gas in the rumen to form into tiny bubbles instead of collecting in large masses. Had Dr. Phillipson any comments to make on the reason why cows could be protected from tympany by giving hay before pasturing, as experiments had shown that cows may consume larger quantities of legume without ill effect, and that the accepted explanation that the cows consume less legume, because they had partially satiated their appetite with hay, was not correct.

The investigations quoted on the numbers of bacteria present in the rumen on various diets were of significance. In practice sound foodstuffs, such as bean meal, were sometimes blamed for causing digestive disturbances, particularly in cows. This so-called "poisoning" was often due to the feeding of large amounts suddenly without gradual introduction, as its digestion needed a complete change of bacterial flora and time was necessary for their development.

The speaker had referred only to the normal syntheses of the vitamin B complex. It was probable that in some abnormal conditions the flora of the rumen might fail to produce enough of the B vitamins to meet the requirements of the animal, particularly in calves in which the quantity synthesized was limited, and as very little was stored symptoms of a deficiency might become manifest. One thought particularly of thiamin (B_1), a deficiency of which had been shown to produce muscle cramp in calves, and riboflavin (B_2) which, if absent, led to a cessation of growth. It was probable that in digestive disturbances in calves an outside source of these vitamins was a matter of importance.

Dr. Phillipson had suggested that one reason why it was possible to use urea as a protein supplement for cattle was that the bacteria which proliferated on the nitrogen so provided were digestible. As it was recognized that 20 to 30 per cent. of ingested urea was excreted without being used by the animal, some of it passing to the milk which might contain three times the normal quantity, it appeared that only a percentage of the urea utilized was digested in the way suggested.

Professor J. G. WRIGHT: Whilst he, personally, had nothing constructive to add in regard to the physiological aspect of the subject, Dr. Phillipson's paper had stimulated his thoughts in regard to some problems of disease.

He had been struck by the statement that conditions in the rumen of cattle and sheep were largely anaerobic. When a trochar was inserted into the rumen direct communication was established between the cavity of the rumen and the abdominal cavity without serious results. It was reasonably certain that no aerobic organisms were introduced and apparently the peritoneum was able to deal with anaerobes. Referring to the operation of rumenotomy, he stated that Goetze, who performed many of these operations in Germany, had informed him that he experienced difficulty with anaerobic infection of the abdominal muscles. He personally was not certain that Goetze was right, having done many without infection. Goetze developed a technique of suturing the rumen to the parietal peritoneum and then closing the wound. On trying this method, Professor Wright had lost two animals with *Clostridium oedematiens* infection. When suturing the wound in the rumen it was possible that the needle might penetrate the mucous membrane and thus an avenue for the passage of infection from the rumen was set up. Direct suture of the rumen to the parietal peritoneum resulted in close contact with the abdominal muscle and the possibility of infection therein, but if, on the other hand, the rumen was allowed to fall back no such contact occurred.

When a cow died from traumatic pericarditis there was frequently a large quantity of stinking fluid in the pericardial sac from which it was possible to isolate *Corynebacterium pyogenes* in pure culture; but from whence did this infection come? This was an aerobic organism—did it come from the rumen? He suggested that this was probably further evidence that *C. pyogenes* gained such sites from endogenous sources, the continuous irritation of the nail causing further multiplication of the organism.

He had been struck by Dr. Phillipson's statement that whether material entered the reticulum or rumen depended upon gravity only. Previously he was rather under the impression that a foreign body was squeezed out of the ingesta during the formation of the cud and thus attained the reticulum. In the light of Dr. Phillipson's remarks his conception was apparently wrong.

He would like to hear more about reticular movements for he wondered what was the explanation of the fact that a pointed foreign body almost always penetrated the anterior wall of the reticulum. Occasionally lateral penetration might occur but he had never experienced a case where the posterior part of the organ was involved. That the measure of contraction of the reticulum was great was evidenced by a recent observation of his where a number of straight pieces of wire had been curled up like curtain rings, apparently as a result of the muscular action of the reticulum.

When mention was made of the relative acidity of the rumen contents, one immediately thought of lead poisoning. The bovine was unique in that, unlike other mammals, it suffered from lead poisoning in an acute form. The oxide and carbonate of lead were very insoluble compounds and yet when cows licked lead paint death could occur rapidly. Dr. Phillipson had said that there was a large amount of acetic acid in the rumen; was it not probable that these insoluble compounds of lead were converted into the soluble acetate and absorption occurred rapidly?

Mr. J. S. STEWARD: He wished to thank Dr. Phillipson not only for a most interesting paper but also for the work which lay behind it. He would like to hear Dr. Phillipson's views on the value of observation of the signs of rumination in regard to prognosis. What could be learnt from counting the number per minute, etc.?

Was there any reason to explain the extraordinary atony of the rumen in cases of piroplasmosis? He, personally, believed that Epsom salts and similar substances had a harmful effect in such cases of atony. Did the speaker agree and could he explain what was the advantage of ammonium carbonate in these cases?

Mr. D. D. OGILVIE: He, too, had listened to Dr. Phillipson's address with the greatest interest. He had always felt that it was surprising and disquieting to find that in the otherwise admirable course in physiology given in the colleges consideration of ruminant digestion was invariably tacked on as an appendage to the general discourse and was prefaced by an apology for the lack of information which was available on the subject. His feeling was that research had centred too much around the posterior regions of the ruminant and he was glad to see now that work on this subject was moving forward at least in an anatomical sense. There were two points on which he should like to have Dr. Phillipson's reactions, but before mentioning these he would like, if he might, to refer to Professor Wright's remarks on lead poisoning. Recently, at Weybridge, he had been told of critical work which was being done on lead poisoning in the ruminant. Contrary to Professor Wright's remarks, it appeared that great difficulty was being encountered in actually poisoning ruminants with lead despite the fact that large quantities of the metal were being fed in various forms. There were doubtless some among the audience who would explain that the best explanation was that the animals around Weybridge, and particularly the bovines, appeared to differ somewhat from the animals in other parts of the country. A practical solution of the matter, in the light of Professor Wright's remarks, might be for the workers involved, to come up and poison some of the Cheshire ruminants which, apparently, were less resistant to unusual interferences of this nature.

Reverting to Dr. Phillipson's paper, the first point upon which he would like to comment concerned the feeding of urea to cattle. Dr. Phillipson had referred in passing to this substance at several points in his address. The matter was of some importance because in America during the war years very large quantities of urea had been used to replace a proportion of the protein in the diet of cattle. Did Dr. Phillipson think that, physiologically, this was a sound procedure and one which could be adopted in this country?

The second matter related to work of outstanding interest and importance which had been done recently in Manchester by the Spanish scientist, Duran-Jorda. Duran-Jorda's work had been based on the observation that in the human subject there is a well established ratio between gastro-intestinal diseases and haemopoiesis. In pernicious anaemia, for example, there is accompanying atrophy of the gastric mucosa. Duran-Jorda's early observations on the stomach of man showed that erythrocytes actually develop from eosinophils. The next step was to determine the origin of these eosinophils. This he was unable to do in the human stomach, but studies of the stomachs of various mammals showed that these cells were present in very large numbers. Observation showed a relationship between these eosinophils and the oxyntic cells. The theory generally accepted and taught in schools that hydrochloric acid was produced by the oxyntic cells had now apparently to be modified and indeed, perhaps dismissed. The main reasons for discounting the theory appeared to be that no acid had ever been detected in the cells, that in atrophy of the stomach all oxyntic cells might disappear but acid was still produced, and that it was more logical to suppose that acid was produced by simple chemical reaction between the sodium chloride in the lumen of the gland and bicarbonate in the blood of the capillaries.

Duran-Jorda was able to find what he was seeking—a demonstration of the relationship between the oxyntic cells and haemopoiesis—in the abomasum of the cow. Here he was also able to show the relationship between the oxyntic cells and the formation of eosinophils. He found that the oxyntic cells actually produce erythrocytes, the stomach therefore being a haemopoietic organ of some significance. Granules are developed in the oxyntic cells which enlarge and are expelled as erythrocytes. At the same time a process of evolution from oxyntic cells to eosinophils is proceeding. In Duran-Jorda's opinion, the eosinophil polymorph is simply a wandering dehydrated oxyntic cell. In addition, there was evidence that the oxyntic cells, as well as producing erythrocytes *in situ*, developed blood-forming cells for the accepted haemopoietic organs, the spleen and bone marrow.

Duran-Jorda felt that his studies should speed up investigations into the use of scientific diets in the regeneration of erythrocytes. It would appear that he had opened up a wide field of exploration and one which, particularly as it involved the ruminant, was specially suited to the veterinary worker.

Mr. G. B. EDWARDS enquired, firstly, if Dr. Phillipson could offer any explanation of the development of chronic acetonaemia in newly calved cows which were stall fed all winter and, secondly, whether the digestive processes described for the ruminant were specialized or did they largely apply to other animals—the horse, for instance?

Mr. W. TWEED, expressing his appreciation of the paper, said that he had noted that nervous control of ruminant digestion was not stressed by Dr. Phillipson. It was obvious that when cows were excited there was an undoubted effect on the digestive organs as evidenced by diarrhoea, etc.

With regard to Professor Wright's reference to the fact that a pointed foreign body almost always penetrated the anterior wall of the reticulum, he suggested that this was very probably due to the contractions of the diaphragm.

Mr. G. N. SHIRLEY wished to raise two questions. Firstly, why was it that tympanites could occur in one particular animal whilst others on the same diet were unaffected, and, secondly, could Dr. Phillipson suggest why arsenic was never prescribed in bovines?

Mr. A. J. WRIGHT, adding his thanks to those already expressed by other speakers, said that he wondered if Dr. Phillipson could refresh their memories on the

mechanism of cudding. Referring to the question of the non-digestion of whole oats and wheat, he wondered if this also could be explained by the effect of gravity. Did such material pass straight into the reticulum and not enter the rumen for attack by bacteria?

Dr. R. Scarisbrick enquired if Dr. Phillipson could say if alcohol was formed as a result of yeast fermentation and were toxic amines formed as a result of proteolytic digestion.

Mr. J. Francis: He had enjoyed listening to Dr. Phillipson's stimulating account of ruminant digestion. Dr. Phillipson had mentioned several other workers at Cambridge but it was really due to Phillipson's pioneering work that any interest was taken in the subject and the various types of work now being carried out were from his observations.

Mr. Francis felt that one of the speaker's most striking statements was that bacterial and protozoal fermentation in the rumen was the most important phase of the digestive process in the ruminant. Despite this, only a few years ago very little attention was given to it in the physiology course at the Royal Veterinary College and much time was devoted to enzymotic digestion. It was sometimes said that this was because so little was known about ruminant digestion but if anyone had had sufficient interest to search the literature they could have collected a great deal of interesting information and given a coherent account of the subject. To-day there was much more information but it would not be presented to students unless there were teachers at the colleges interested in the subject. The best way to arouse this interest was to provide facilities at the colleges for research into ruminant digestion and other aspects of physiology which were particularly important in veterinary medicine.

Mr. I. G. Shaw: The speaker had told them of vitamin B_1 and its synthesis but did not mention vitamin C and its breakdown. The bovine obviously acquired a considerable amount of this vitamin in the large quantities of greenstuff consumed. Could Dr. Phillipson say anything in regard to this; was it used directly by bacteria and other organisms?

Mr. H. Brassey-Edwards suggested as an interesting point for future investigation the fact that in East Africa cattle which lived on "bush" were able to exist for three days without water. It was also a well-known fact that the camel could go for several days without water.

Mr. D. W. P. Bythell asked if Dr. Phillipson could help in regard to the condition of tympanites of cattle on new leys. He had said that this occurred after 15 minutes in sheep but in cattle ten minutes or less was sufficient. Was the spreading of yeast and protozoan organisms a factor—a new ley might be virtually sterile?

The President: (Major Mattinson), in winding up the discussion, said that Dr. Phillipson had said in one connection "when the rumen is empty." He personally had never seen the rumen empty even after many days starvation. He agreed with Mr. Steward in his reference to the importance of the observation of cudding as an aid to prognosis. On the matter of the digestion of whole oats he thought the solution was comparatively simple, for if a horse and cow were given a similar quantity of whole oats the horse would take three times as long to consume them—he masticated them whereas the cow did not and, in the latter, the oats passed unchanged into the alimentary tract. The discussion had undoubtedly shown that the subject was of much practical interest and the paper to be of great value.

The Reply

In his reply, Dr. Phillipson stated that he wanted to thank the members for the kind manner in which they had received the paper and also for the many interesting points that had been raised in the discussion. Mr. King had referred to thirst as a factor favouring the direct passage of liquids to the abomasum; while he agreed that there were positive statements to this effect in the literature, negative results had been obtained by more recent investigations and there was no convincing evidence to show that either hunger or thirst had any influence on the oesophageal groove mechanism. There was no doubt that cupric salts produced closure of the oesophageal groove in the majority of animals; sodium salts were ineffective in sheep, but Wester had stated that they produced closure of the groove in some cattle. There were no available reports of any experimental results regarding the use of copper salts in cattle. The practical measures concerning the use of copper sulphate as recommended by Watson were as follows:—

Liquid may be expected to pass to the abomasum most frequently if it is delivered into the mouth not less than five seconds, and preferably about eight seconds, after a small quantity of a solution of copper sulphate.

The dose of the solution of copper sulphate should have a volume of about 10 ml. and the concentration of the salt should be as high as possible; 0·4M (10 per cent.) solution of copper sulphate is safe for adult animals, but this must be reduced to 0·16M (4 per cent.) for lambs under four months old.

Both the dose of copper sulphate and the subsequent medicinal dose should be delivered into the posterior part of the mouth.

If the copper sulphate solution is used as a vehicle to carry another liquid to the abomasum, the total volume of liquid should be as large as possible without reducing the concentration of the copper salt below 0·08M (2 per cent.) so that mechanical stimulation is increased and the possibility of all the dose being swallowed before the groove closes is reduced.

The question of tympanites was also raised by Mr. King and others, and the subject was best discussed as a whole. The explanation put forward by the Americans to account for the fact that feeding hay before turning cattle on to leguminous pastures prevented bloat, was that the eructation of gas was a reflex stimulated by the presence of fibrous food in the reticulo-rumen sac. If fibre in the form of hay was supplied, then the animal had no difficulty in getting rid of the gases formed in the rumen; if, on the other hand, they were pastured on young growing legumes, in which the fibre was entirely unlignified and so produced little stimulation, then the reflex was not stimulated and the gases accumulated in the rumen. Considering the whole problem, the crucial point to decide was whether or not distension of the rumen was in itself a cause of death or was the rapid evolution of gas accompanied by the production of a toxic product, which was the lethal factor. Dr. Scarisbrick had suggested that toxic amines might be produced from proteolytic digestion in the rumen and he agreed that amines might possibly be the lethal factor in tympanites. It was not easy to answer the question raised by Mr. Shirley why only a few animals out of a herd were affected; whichever line of thought one preferred—the pressure theory or the toxic theory—one would expect that the majority of animals in a group would be affected. The probable answer was that the individual behaviour of the animals was important. Greedy feeders which ate rapidly might produce a more intense fermentation than animals which grazed steadily, but slowly, and had a better chance to keep pace with the products of digestion.

Returning to Mr. King's next point about vitamin B deficiencies in calves, he thought that, with suckling calves before they were fed much solid food, the position regarding B deficiencies would be the same as with other animals, but in any calf which had started to take substantial amounts of solid food one should be very cautious, and make sure that the synthesis of members of the B complex in the rumen was deficient, before accepting B deficiency as the explanation of any syndrome.

He was interested to hear Professor Wright's experiences with the operation for rumenotomy as it confirmed his own in that ruminants were resistant to peritonitis following surgical interference with the rumen. He had not had losses through anaerobic infections of the abdominal wall, even though the operation, in which a cannula was inserted into the rumen and brought out through the abdominal wall, resulted in the rumen becoming fixed to the abdominal wall in the region of the cannula; but in this operation drainage was allowed round the cannula. The main mishap that might occur following these operations, apart from displacement of the cannula, was subsequent pyogenic infections at the site of operation. These were usually confined to suture abscesses, but they occasionally became more severe. Even so, only a small percentage of cases were complicated in this way. It seemed probable that, owing to the ubiquitous nature of *C. pyogenes*, it would be present in the rumen contents, as Professor Wright suggested, and that these organisms proliferated if they gained access to tissues damaged by trauma, following penetration of the wall of the reticulum by a foreign body. The contractions of the reticulum were best appreciated by direct radiological observation of the barium-filled organ. The movements were brisk and the whole organ gathered itself together and contracted in two stages; in the first stage it contracted to about half its resting size and in the second stage it reduced itself to the size of an orange. The greatest movement was seen on the anterior surface of the organ and this was probably the reason why it was the site of penetration by sharp foreign bodies. The movements of the organ would certainly tend to bend any piece of wire that was soft enough into a circle and he could well believe that this could happen, particularly if the end were bent to start with so that penetration of the wall was not easily accomplished.

The point raised by Professor Wright, regarding lead poisoning, was particularly interesting. The *p*H of the rumen usually fluctuated between 6 and 7, so that the amount of free acetic acid present was not large, although some would be present; feeding an easily fermentable diet, which contained soluble carbohydrate, would result in a greater production of the three fatty acids, particularly acetic, and, consequently, a fall in *p*H, which might drop to the region of 5·8 or even lower; while in animals fed on hay the *p*H remained in the region of neutrality. As the amount of free acetic acid increased, so the possibility of lead acetate being formed increased and the likelihood of lead poisoning occurring. Summing this up, he thought that animals grazing young summer grass would be much more likely to contract lead poisoning following the ingestion of lead paint, etc., than store animals fed largely on coarser foods. It would be extremely interesting to see whether there was any correlation between the diet and the incidence of lead poisoning in cattle, on the lines he had suggested, and he suggested that Mr. Ogilvie should obtain details of the exact rations fed to the experimental animals at Weybridge.

Mr. Steward asked him whether the signs of rumination were of any value in prognosis. His clinical experience was too limited for him to give any answer beyond the general statement that if a cow was well enough to eat she was well enough to ruminate. It was not necessarily a sign of ill health if a cow ruminated very little, as the time devoted to rumination was found to depend upon the fibre in the food and animals fed entirely on concentrates ceased to ruminate; such animals, although described as being listless, were not necessarily ailing. As regards the rest of Mr. Steward's questions, he had no explanation to offer.

Regarding the use of urea as a protein substitute, the evidence produced by Dr. Smith, of the Hannah Institute, left one in little doubt that the urea was utilized by the bacteria of the rumen, and, provided sufficient starch was present, nitrogen of the urea was incorporated into the bacterial protoplasm; evidence was still needed as to the biological value of bacterial protein, but the fact that urea could, generally speaking, replace up to one-third of the protein in the ration, without inevitably producing loss in condition or drop in milk yield, left little doubt that the bacterial protein was of good nutritional value. The fact that some of the urea was not so utilized, as was pointed out by Mr. King, was a little disquieting and one had to consider whether or not feeding urea over long periods would have any detrimental effects. There was no reason why a cow could not excrete a little urea without ill effect, but until the experiment was tried over a period of years no positive answer could be given. The efficiency of urea as a protein substitute, according to results obtained from the Hannah Institute, depended upon the amount that was utilized in the rumen; thus cows that excreted a substantial proportion in the urine derived least benefit, while those that excreted only a small proportion derived most benefit. Evidence was also produced that cows need some time before they made the best use of urea, presumably, while adjustments in the flora were taking place—a lag that was common to many feeding-stuffs. The use of urea as a protein substitute appeared to be justified provided it was fed in combination with true protein and did not exceed one-third of the nitrogen requirements of the animal and provided it was fed with sufficient starch, not only to make up its calorific value to that of true protein, but also to allow its most efficient use in the rumen. It was best given as a composite cake with the necessary protein and starch so that these conditions were adhered to.

The account Mr. Ogilvie gave of Duran Jorda's work was very interesting and controversial; it was the first time that he, the speaker, had heard of it and, consequently, he felt no obligation to make any comment.

The question of acetonaemia in newly calved cows, raised by Mr. Edwards, was another problem to which there was no answer; all that could be said was that acetic and butyric acids were ketogenic, particularly when the liver was poor in glycogen. If a cow was allowed to get into a poor condition during the later stages of pregnancy and finally ate little, if anything, round about parturition, the liver became depleted of glycogen, so that, when she came back on to full feed, ketones might appear in abnormal amounts in the blood. The fundamental question was whether ketonaemia was, in itself, a pathological condition producing the syndrome or whether it was a manifestation of some deeper seated disturbance. As far as was known, the same kind of digestion occurred in the large intestine of the horse as in the rumen of the cow, for the same mixture of acids was present; but, beyond this fact, little was known about it.

Mr. Tweed asked about the nervous control of the stomach. Work had been done on the subject in Germany and Sweden. Experimental section of various branches of the abdominal vagi indicated that the movements of the stomach were dependent upon the integrity of the vagi. Two common results, depending upon the branches of the vagi sectioned, were: (1) pyloric stenosis; (2) stenosis of the reticulo-omasal orifice. If both abdominal roots of the vagi were sectioned, then the whole stomach was paralysed and tympanites developed. Hoflund, in Sweden, had described clinical conditions, such as tuberculous enlargement of the mediastinal lymph glands and adhesion between the anterior surface of the reticulum and the diaphragm, as a result of perforation by a foreign body, which might produce symptoms similar to those obtained experimentally. In the former case, this was so if the thoracic vagi were involved and, in the latter, if it were the abdominal roots of the vagi.

In answer to Mr. Shirley's question, he regretted that he had no idea why arsenic was not prescribed.

Mr. Wright had asked for an account of the mechanism of cudding. This was a subject which it would take a long while to discuss if all the evidence was to be sifted. To-day it was generally accepted that regurgitation was accomplished by the cow making an inspiratory effort with a closed glottis, so that the oesophagus was dilated and digesta flowed into it, that is to the region of low pressure. This mechanism was first discovered in 1875 but, with one exception, it had only recently found its way into any of the textbooks. Prior to regurgitation, the reticulum contracted and, at the end of its normal movement, made a third contraction after a slight pause, after which it relaxed to some extent. This ensured that the cardia was flooded with semi-liquid digesta, for the inspiratory effort occurred immediately after the third contraction. The digesta, once it was in the oesophagus, was carried to the mouth by a wave of antiperistalsis. The liquid was swallowed soon after the material reached the mouth and the bolus, when it was finally reswallowed, passed back to the anterior region of the reticulo-rumen sac. Wester maintained that the oesophagus, the musculature of which was composed of striated muscle throughout its whole length, actively contracted and, on account of its

attachments to the stomach, dilated in the thorax and so was itself responsible for the fall in pressure within its lumen and was only aided by the inspiratory effort. If this were so, one might expect that a cow, with an open trachea, could regurgitate without much difficulty, but as, in fact, a cow with an open trachea could only regurgitate with great effort, and then only after a period of adjustment to the new conditions, one could say, at least, that the inspiratory effort was a very important part of the mechanisms concerned.

Regarding the question of whole oats and other grains, the answer seemed to depend upon the fact that the husk of oats and the outer coat of the wheat grain were resistant to bacterial attack; in addition to this, the small size of these grains meant that the passage of any that entered the rumen was more rapid than that of roughage, while, as Mr. Wright suggested, some might pass directly to the reticulum and so escape the rumen.

In reply to Dr. Scarisbrick, regarding the formation of alcohol, this point had crossed the mind of his colleague, Dr. Elsden, who had looked for it in the rumen contents of sheep with a rich flora of yeasts, but he had not found any. It was possible that alcohol formed an intermediary stage in the production of acetic acid, but if it did, it could only be a transitory stage, as it never accumulated in detectable amounts.

He thanked Mr. Francis for his generous remarks, but he must point out that before he started work Drs. Woodman and Evans had approached the problem of fermentation of carbohydrates, and had worked with sheep with fistulae, but their results, obtained *in vivo*, had never been published and so no one knew how far they had got.

He entirely agreed that animal physiology could be taught in the colleges to a greater extent than it was at present, but the time factor had to be considered. At present, one year was barely sufficient to allow the principles of general physiology to sink in and there was not sufficient time to deal with the subject in a more comparative manner.

In answer to Mr. Shaw's question regarding the synthesis of vitamins in the rumen, he knew of no evidence to indicate that vitamin C was synthesized in the rumen: in fact, the opposite appeared to be the case, for ascorbic acid, when added to rumen contents *in vitro* or *in vivo*, rapidly disappeared; presumably it was utilized by bacteria.

Mr. Brassey-Edwards' statement that cattle could live for three days without water in East Africa was interesting. He had always understood that in the case of the camel the ability to go without water for days on end was due to the production of metabolic water from the metabolism of fat composing the hump, but it was difficult to understand how cattle managed.

He was afraid he could not be of much help to Mr. Bythell regarding the occurrence of tympanites in sheep and cattle on new leys. He had already indicated his views on tympanites and had nothing more to add. The spread of organisms, such as protozoa and yeasts, appeared to be due to direct contact between animals, at any rate as far as the protozoa were concerned; in any case the absence of yeasts from the rumen meant that gas production was less rapid however desirable yeast cells were in other directions.

He apologized to the President if he had talked of an "empty rumen" occurring naturally: it did not. In many experiments he washed the rumen out through a fistula, and so emptied it, and perhaps he had not made himself clear on this point. He agreed that the question of mastication was an important fact in determining whether or not whole oats were digested.

Finally, he would again like to thank the meeting for the interest it had shown in what he had to say.

SCOTTISH MILK TESTING SCHEME

Details of the Scottish Milk Testing Scheme, the immediate objects of which are to detect and eliminate as far as possible milk of unsatisfactory keeping quality and gradually to raise the general standard of milk supplies, are set out in a memorandum which was issued by the Department of Health for Scotland on January 22nd.

It has been drawn up the Secretary of State in accordance with the Government's policy of improving the nation's milk supply and after consultation with the various bodies concerned in all stages of milk production and distribution: the local authorities, the producers, the distributors, the Milk Marketing Boards, the Agricultural Colleges, and the Ministry of Food.

The scheme provides machinery for directing the attention of local authorities to those producers and distributors whose supplies are not satisfactory so that they may be encouraged to improve their methods. Continued failure to satisfy the tests will be investigated in the first instance by local authorities from the point of view of compliance with the Dairy By-laws and Orders. In cases of persistent difficulty on the part of producers, they will be advised by local authorities to consult the Agricultural Colleges.

The scheme will be operated in the first instance on an experimental basis for a period of 12 months, after which it may be reconsidered with a view to any desirable modification. It consists of two main parts, namely, the sampling and testing of all milk supplies delivered to distributors' premises and the sampling and testing of all milk supplies leaving distributors' premises.

The tests prescribed will be carried out by milk testers employed by the distributors and approved for the purpose by the Department of Health, who will also be responsible for approving the facilities for testing purposes at each distributor's premises.

In addition to the normal supervision by the local authorities in their area, a general supervision over the scheme will be exercised by the Department of Health, whose milk inspectors will make inspections of the sampling and testing arrangements and the records kept by distributors.

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The Navy, Army and Air Force have agreed upon the proportion of doctors to be retained in the Services as two for 1,000 Servicemen. Under the revised plans, doctors will be released at an increased rate.

ABSTRACTS.

[Induced Ovulation and Heat in Anoestrus Sheep. Hammond, J., jun. (1945.) *J. Endocrinol.* **4**. 169-180.]

The effect of single injections of pregnant mares' serum gonadotropin (PMS) either alone or along with an injection of stilboestrol was studied in some 90 sheep. The time of onset of oestrus was noted and the reproductive organs were carefully examined when the sheep were slaughtered four to six days after the injections. All the sheep injected with PMS alone were found to have ovulated but none had come into oestrus. With stilboestrol alone or in conjunction with PMS, it was observed that oestrus was more frequent in those sheep which did not ovulate. In cases where both oestrus and ovulation occurred, the time relationship appeared to be unfavourable for fertilization as only two fertilized ova were recovered although the ewes had been run continuously with the ram. It is concluded that there seems little prospect of obtaining a treatment for induced fertility in anoestrous sheep based on the use of PMS and stilboestrol.

A. T. C.

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[Chemotherapy in Experimental Tetanus. Evans, O. S., Fuller, A. T., and Walker, J. (1945.) *Lancet*. **249**. 336.]

Using groups of 20 mice, the authors compared the therapeutic value of V187 (para-methysulphonylbenzamidine hydrochloride), V335 (para-methylsulphonylbenzylamine hydrochloride), marfaril and sulphathiazole in experimental tetanus. The drugs were injected into the same site as the previous injection of vegetative tetanus organisms. None was of value if injected four hours after the injection of the organisms but if the interval was only two hours V187, V335 and marfaril showed marked protective properties while sulphathiazole was valueless.

P. S. W.

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[Relative Effects of Dietary Constituents and Other Factors upon Calculus Formation and Gingival Disease in the Ferret. King, J. D., and Glover, R. E. (1945.) *J. Path. Bact.* **57**. 353-362.]

A form of gingival disease was found to be common in laboratory ferrets. Gum lesions first arose in the carnassial regions of the mouth near the openings of the parotid ducts, and were accompanied by the deposition of salivary calculus (tartar) on the adjacent teeth. It was shown that the gum lesions were the direct result of trauma by this tartar. In the further progress of the disease, which was probably aided by secondary bacterial action, there was an increase in amount of the tartar accretions, the gums becoming swollen and haemorrhagic; in the later phases there was gingival atrophy, resorption of the alveolar bone, erosion of the cementum and dentine, formation of parodontal abscesses, and loosening of the teeth.

It was suspected that the disease was related to war-time modifications of the diet, including restriction of the meat supply, and less frequent access to bone-containing carcases. Experiments were carried out in which ferrets received one of three basal diets, in which the chief ingredients were oatmeal or bread or meat. In each group, all the animals developed tartar and gum disease except those receiving a supplement in the form of pieces of rib-bones with their periosteal, muscular, and tendinous attachments: these bones were not eaten completely, but the mechanical friction from chewing them was sufficient to keep the teeth free from tartar and the gums healthy. Coarse dog-biscuits also had a certain protective effect, but the disease eventually supervened. Crushed or macerated bone, commercial bone-meal, or finely powdered dog-biscuit had no prophylactic effect. Animals with the disease were cured when they were given the bones plus attachments, but the condition reappeared when this supplement was withdrawn. Frequent scaling of the teeth was relatively ineffective in preventing the formation of tartar in quantities sufficient to injure the gums.

E. C.

Weekly Wisdom

". . . I marvelled that this animal should be, to many men and women and children, but to one in particular, so single-minded, so jovial, so selfless in its devotion; and when I considered that often I was careless and unkind, in my moodiness and irritability; that if I spoke harshly to it the brightness went from its eyes, and the straightness from its back; and yet at a releasing word, no matter how incomprehensible the harshness, its whole being would light up and dance with gratitude; and when I consider, moreover, that I have an immortal soul according to the Church, and this animal has none. . . ."—Henry Williamson—"Life in a Devon Village."

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Veterinary Educational Trust.—Part of the proceeds of the sale of racecards at the National Hunt Festival at Cheltenham will be devoted to the Veterinary Educational Trust for research work

Questions and Answers

"Questions and Answers" will be published on alternate weeks.

The submission of questions for inclusion in this column will be welcomed: they can relate to any aspect of veterinary work. For purposes of record, each question is numbered, and those submitting questions are required to furnish (not for publication) name and address.

Answers to readers' queries represent exclusively the personal opinions of the writers, and criticism of the replies will be appreciated.

All communications should be addressed to the Editor.

Treatment of Actinomycosis and Actinobacillosis

Q. CXLIII.—*What is the dosage, frequency and usunal number of treatments required in the treatment of wooden tongue by sodium iodide intravenously?*

Why are some cases of this disease incurable; are the causal organisms likely to acquire a tolerance to iodine if the initial dosage is inadequate?

What are the possibilities of sodium iodide subcutaneously? What are the chances of curing lumpy jaw by this or other means?

A.—The usually recommended dose is 1 oz. dissolved in about 12 oz. water, given intravenously. This should be repeated at eight- to ten-day intervals until three injections have been given.

Recently the writer has been increasing the dose to 1½ oz. in well-developed animals and this may be given with safety to Shorthorn or Friesian cows, but in the case of the smaller dairy breeds the smaller dose is adequate.

Earlier American writers suggested shock and abortion as possible sequelae, but in the course of several hundred treatments the writer has met only a few mild cases of the former, and none of latter.

It must be remembered that the term "actinomycosis" as commonly used applies both to infections by the actinobacillus (usually in the soft tissues) and actinomyces (usually in the hard tissues). The former condition responds in almost 100 per cent. of cases to iodine treatment, provided that it is maintained for a sufficiently long period (usually three weeks). The latter is, however, much more stubborn, and if once well established, may be held in check by iodides, but is unlikely to respond completely to this or other lines of treatment. There is no evidence to suggest that either organism acquires a tolerance to iodine.

In the case of bony lesions which are treated, although the infection may be killed out, permanent abnormality may remain. A light blister of biniodide of mercury may be used to advantage here.

When the infection takes the form of "lumps" around the mandible, surgical removal may be attempted, combined with local and oral or intravenous iodine therapy.

The subcutaneous route of injection does not seem suitable for sodium iodide, due to the irritant effect of the iodine ion.

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Administration of Pentothal Sodium

Q. CXLIV.—*Is the administration of pentothal sodium possible by any other than the intravenous route, the technique of which is difficult in some cats?*

Is administration by the intraperitoneal route to be advised?

A.—Pentothal sodium is classed as one of the very short-acting barbiturate anaesthetics, the duration of anaesthesia varying from five to 20 minutes according to the rate of administration. The use of pentothal sodium in dogs by the intraperitoneal and subcutaneous routes has been tried without success, and injection intravenously is the only method recommended. It is best not employed where there is any marked interference with the respiratory function. The drug is very rapidly detoxicated in the liver, hence the intravenous route is the only one giving sufficient concentration in the blood stream to cause anaesthesia. Absorption of drugs from the peritoneal cavity is complete in ten to 15 minutes, and from the subcutaneous tissues in 15 to 30 minutes; thus it will be realized that if a computed dose of the drug be injected into either of these tissues a very large proportion of the drug will have been detoxicated before an anaesthetic dose has been absorbed.

Furthermore, the solution of pentothal sodium is highly irritant and is quite unsuitable for injection into tissues other than a vein. The accidental injection of a small quantity of the solution into the perivenous tissues during an intravenous injection is sufficient to cause a marked pain reaction on the part of the animal and may be followed by a comparatively large slough.

In human surgery pentothal acid is often used. Perhaps some members who read this correspondence, and who have experience with pentothal acid as an alternative to the sodium salt, will submit a few notes for publication.

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"Waterbrash"

Q. CXLV.—*What is "Waterbrash"; how does it arise and what is the remedy?*

It is a Scottish term, used to indicate the discharge of a clear colourless fluid from the mouth in human beings. I have observed a similar condition in dogs as noted by discharge, without much expulsive effort, of a CLEAR *colourless fluid.*

A.—Waterbrash (or pyrosis) is a condition characterized by the sudden emission through the mouth of a watery fluid from the stomach—usually in the morning. It does not seem to be attended by straining or retching and it is generally regarded as a hypersecretion of saliva, swallowed during the night and due to reflex irritation in the stomach. It is met in dyspeptic conditions and fairly often in peptic ulcer. Pyrosis is not common among dogs, but if occurring may be countered by the usual anti-dyspeptic remedies.

Death of Dr. Fred Bullock, LL.D., Barrister-at-Law

Secretary and Registrar, Royal College of Veterinary Surgeons

It is with profound regret that we have to announce the death of Dr. Fred. Bullock, Secretary and Registrar of the Royal College of Veterinary Surgeons, which took place at his home, 10, Great Russell Mansions, Great Russell Street, W.C.1, shortly after midday on Thursday, February 14th, on the last day of his 67th year.

As our readers will be aware, Dr. Bullock's health had given rise to considerable anxiety since, in July, 1945, during the first week of his holiday, he was taken ill with an alimentary disorder which sorely taxed the strength of one who had always defied a frail constitution with a determined will. It is now sadly evident that the combination of worry and overwork occasioned by such factors as the evacuation of the Royal College and the additional duties imposed on him in connection with the measure recently successfully opposed before select committees of both Houses of Parliament, and those concerned with governmental negotiations regarding veterinary education, hastened his end. His own insistence upon return to duty at Red Lion Square towards the end of last year brought all too soon the relapse feared by the Officers and Council of the College, and in February he again had to give up and entered a nursing home as recorded in our last issue. He left the home after a brief stay, only to pass away suddenly two days afterwards. Thus has self-sacrifice to duty—for Dr. Bullock was well past the normal age of retirement—called away one in whose learned and conscientious service the Royal College has always felt itself to be uniquely fortunate, while countless members of the profession will mourn the loss of a shrewd and kindly counsellor and a good friend.

We hope to publish a biographical tribute in an early issue. In the meantime it should be recorded that Dr. Bullock would have completed 40 years' service in June, 1946. "Called to the Bar" in Gray's Inn, 1926, with first-class Honours in the Law of Real Property, his thesis on "The Law Relating to Medical, Dental and Veterinary Practice" brought him the coveted Doctorate of Law in 1928. Dr. Bullock's utilization of his profound knowledge of the French language and literature, in bringing to light hitherto obscure facts appertaining to the opening up by the French of the Ivory Coast in Africa, were recognized by the French President by his appointment as Officier de l'Ordre du Nichan Iftikhar (Tunis) (1929); Chevalier de la Legion d'Honneur, in 1934. His contributions to veterinary literature were of great value, including, as they did, his "Handbook for Veterinary Surgeons," a section in the 14th edition of the "Encyclopaedia Britannica" and the editorship of Volume IV of Smith's "History of Veterinary Literature" (1933), while his work as custodian of the Royal College of Veterinary Surgeons' War Memorial Library, now the "Central Library for Animal Diseases," has done much, amongst his many other activities, to enhance the status of the profession. Dr. Bullock was a natural and eminently successful choice for the arduous post of General Secretary of the International Veterinary Congress, held in London in 1930.

Dr. Bullock's enthusiastic work for the Victoria Veterinary Benevolent Fund was of great assistance to the charity, and his concern for its welfare is reflected in his wish that, in lieu of flowers, donations should be sent to 9, Red Lion Square, W.C.1.

On behalf of the profession he served with such distinction, we extend to Mrs. Bullock—herself an Honours Graduate in Law—who did so much to share with her husband the "heat and burden of the day" at Red Lion Square, and to their son, Wilfred, our deepest sympathy in their great loss.

IN PARLIAMENT

Agricultural Policy

On Thursday of last week the House of Commons engaged in a wide and searching debate upon the world food situation, touching upon the many aspects of the subject which have been freely discussed in the country and at Westminster since the Ministers of Food and Agriculture made their statements in the Commons. The debate on the following day turned out to be largely a post-script to the former: the full discussion of long-term policy for farming has been postponed.

Mr. Tom Williams, Minister of Agriculture, said that, in view of the world wheat shortage, farmers would be called upon to put under tillage at least the same areas this year as last: the ploughing-up grant of £2 an acre for grassland that had been down to grassland for seven years would be extended to grassland that had been down for only three years.

With regard to future policy, he was now engaged in discussions with the various interests concerned about the powers, functions and constitutions of county committees. When reconstituted they would be selected partially from panels of names put forward by interested parties and partly selected direct from people with professional, technical or expert knowledge of some phase or type of agriculture or horticulture in some part of the country. He hoped to reconstitute these committees under existing powers as an interim measure and perhaps they could see how they worked out between now and the time when legislation could be introduced.

The agricultural executive committees would be incorporated with the national agricultural advisory service and charged with the general responsibility for promoting the efficiency and well-being of agriculture. They would have powers of control and could undertake other executive duties as they did during the war. The county committees would have power to service compulsory direction, but, except in special circumstances, those powers would only normally be used for farms under supervision. Appeal tribunals were being set up corresponding to the regions of the national agricultural advisory regions. Two tribunals were in operation and six more were to be set up.

The National Advisory Service

Proceeding, the Minister said: "As far as we can, we are pressing on with the educational side of our policy and we hope to establish the National Advisory Service on October 1st, in spite of all the difficulties of accommodation and otherwise. We also propose to establish several experimental farms and horticultural stations where farmers will see the practical application of research as they have seen it at demonstrations conducted during the war on varying soils and under varying climatic conditions. Side by side with the National Advisory Service, agricultural education ought also to be developed and hon. Members will have seen the report on higher education published two weeks ago. Details obviously require examination, but I agree generally with the committee's outlook and recommend the report to universities, colleges and others interested.

"There is also a report on farm buildings, and a further report on the mission which went to the United States recently to look into the question of farm buildings there. The Agricultural Improvements Council have these two reports in hand, and steps will be taken shortly to investigate many of the recommendations which were made. . . .

Animal Health

"I want to refer briefly to the question of animal health. Some journalists seem to imagine that because the Ministry of Agriculture are not talking of their activities in regard to animal health that they have completely forgotten it. Animal husbandry—live-stock improvement—is the very keystone of our agricultural economy. Maximum efficiency is essential to meet our national needs and the ultimate prospect of British farming. Good breeding therefore—and this is not the first time those words have been used; my right hon. Friend the Member for Southport used them so often that they sent me dizzy—must become the general practice, and we are offering all the assistance and advice we can to commercial breeders and other farmers. The threefold improvement policy is, a consistent campaign to get farmers to use good stock and sound breeding, eradication of disease, and up-to-date stock management and economical feeding, which means making the best use of such feeding-stuffs as are available.

"I would like to say a word on animal disease and the unremitting fight which has been going on for some time to reduce the crippling losses which have affected farmers for so long. There has been one limiting factor recently, the shortage of veterinary surgeons, a handicap which has been slowly removed as veterinary surgeons come back from the armed Forces, but many more are needed. They ought perhaps to be more highly trained, and I am making arrangements for facilities in private practice. The Loveday Report recognized that better facilities should be provided for more research. Discussions with the Royal College of Veterinary Surgeons and the universities have not been without some difficulties. I can, however, say that we have reached a substantial measure of agreement, and concrete proposals are before the Government; and I hope very shortly to be able to make a statement."

Replying to Mr. C. Williams, who spoke of the difficulty of discussing both short-term and long-term policy in the time available, Mr. T. Williams said that he would have no objection to moving the adjournment at the end of the day so that the debate could be continued on a subsequent occasion.

Mr. Hudson on Subsidies

Mr. R. Hudson, giving a general welcome to the Government's statement of policy on November 15th, said the Minister thoroughly deserved the congratulations he had received. That policy was based largely on the work Mr. Williams and he had done during the coalition, and on the conference of the Royal Agricultural Society.

He (Mr. Hudson) had consistently warned farmers against relying on subsidies, on the ground that sooner or later the Chancellor of the Exchequer would "kick." Subsidies in the past had been regarded as a help to primary producers, but in recent years they had come to be regarded as a means of keeping down the cost of living. The bald fact was that for the past two or three generations the industrial population had become accustomed to living at the expense of the primary producer. (Hear, hear.) It had now become generally recognized, not only by the Conservatives but also by the Labour Party, that the practice of paying the lowest possible price to the primary producer, here or abroad, was unsound. The urban population was still unwilling to pay an adequate price for food, and the habit was steadily growing of relying on subsidies to the consumer, not at the expense of the primary producer but of the taxpayer.

The present subsidies on food amounted to £300,000,000, ostensibly to prevent the cost of living rising over a purely arbitrary figure. The United States was in the same difficulty. He could not get an accurate figure, but it was clear that their subsidies were greater, and their total substantially greater, than those paid in this country. The result was a wholly artificial basis of price structure, not only as far as individual items of food were concerned but in the relationship between the different foodstuffs themselves. Unless this process was checked, and indeed unless the engine was reversed, we were running a serious risk of trouble throughout the world. Wheat was being produced in this country at prices below what it cost to deliver Canadian or American wheat to our mills. That was fundamentally unsound.

If the Minister of Food had apprised the Minister of Agriculture of the desperate situation, a warning would have been issued about pigs and poultry last October, but the Minister had to come down to the House the other day and say that the promise made last summer would not be honoured. That was the first time a ration had not been honoured. The farmers were now going to incur a heavy loss in the pig and poultry stocks, and there was a moral obligation on the Government, and particularly on the Minister, to see that some *ex gratia* payment would be made to them proportionate to the losses they had incurred. This was not the result of a natural calamity or of a bad harvest, but was directly incurred as a result of the Government's failing to honour the promise they had made.

Mr. P. Snadden said the farmers had been bewildered with the Government's change of policy. There must be a policy for the livestock industry. We were facing a world meat famine as well as a wheat famine.

Mr. T. Fraser, Under-Secretary for Scotland, said that agriculture was far too fundamental to the national economy to allow an element of gamble to be introduced in the future. He agreed with Mr. Hudson in his dislike of subsidies. They should at the earliest possible moment appreciate the full value and true price of the foodstuffs of the country, and ask the consumer to pay for the good, clean, wholesome food that the land could produce.

The debate was adjourned.

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Questions

Pit Ponies

Mr. Murray asked the Minister of Fuel and Power how many pit ponies were engaged in the coal mines in this country in 1925, and how many in 1945; and whether it is his intention to withdraw all ponies from the coal mines and install mechanical haulage.

Mr. Shinwell: In 1925 the total number of horses and ponies employed at coal mines was 60,852. By 1945 this number had fallen to 23,491, and I have no doubt that it will continue to fall and that horses and ponies for underground haulage will be gradually displaced as the reorganization of the industry proceeds.

National Agricultural Advisory Service

Lady Noel-Buxton asked the Minister of Agriculture, as the National Agricultural Advisory Service is open to both sexes, whether women officers of his Department, or other suitably qualified women, will be consulted in the short-listing of applicants, and will sit on the select committees set up to interview candidates.

Mr. T. Williams: The selection of candidates for this service is being conducted by the Civil Service Commissioners in association with my department. The preliminary examination of the applications will be carried out by suitably qualified persons and the Selection Boards will, if possible, always include a woman member when women candidates are interviewed.

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Welsh Department of Agriculture

Squadron-Leader Emrys Roberts asked the Minister of Agriculture what are the precise status and functions of the Welsh Department of the Ministry of Agriculture and Fisheries; what administrative responsibilities are delegated to the Welsh Department; and what are the channels of communication between the head of the Welsh Department and the Minister of Agriculture.

Mr. T. Williams: The Welsh Department is responsible for advising on the Welsh aspects of the formulation and administration of the Ministry's policy generally, and in particular for administering in Wales the Ministry's policy in regard to livestock improvement, education and advisory matters, and land management (including the constitution and functions of county agricultural executive committees in Wales). For this purpose the Welsh Secretary is kept in close touch with the work of the Department generally, and the heads of the various divisions of the Ministry are under instruction to consult him at the appropriate stage to ensure that any particular Welsh aspect of policy with which they are dealing is taken into consideration before a final decision is reached. This consultation is facilitated by the Welsh Secretary's frequent visits to headquarters and by a direct telephone line and a teleprinter service. The Welsh Secretary, who ranks as an Assistant Secretary of the Ministry, is directly responsible to the Permanent Secretary of the Ministry for the general conduct of the work of his Department, and through him has the right of access to the Minister.

EXTENSION OF JERSEY A.I. MATING

An important development of artificial insemination procedure (reports the *Farmer and Stock-Breeder*) has been initiated by the English Jersey Cattle Society with the approval and co-operation of the Ministry of Agriculture. It will make available, over a wider area than has hitherto been possible, the semen of good Jersey bulls in more private herds and the collection of the semen on more numerous occasions.

Privately owned bulls have so far been subjected to somewhat severe restrictions. No more than 15 collections of semen in a year could be taken from one bull, and the semen could not go into more than five different herds. This discouraged owners from securing licences for bulls unless they had exceptional transport facilities for the despatch of the semen.

Henceforward the licensing of privately owned Jersey bulls will be according to the Jersey population in each county. The Ministry will have no objection to any number of collections being taken, and made available to all herds within the county. With the easier conditions relating to petrol, it is anticipated that cow-owners will be able to go to the farms where bulls are privately kept, and pick up the semen, taken under regulated conditions, and have the insemination operation carried out by a veterinary surgeon. It is understood that proper cooling and storage facilities are to be provided. It is thought that this arrangement will make available the semen of special bulls within a radius of 30 miles and an unlimited collection within a county. It is anticipated that the semen of bulls of famous families and famous blood strains will thus be available throughout the country. An immediate start is to be made by the E.J.C.S. in an area comprising Kent, Sussex, Surrey and Hants.

Although the Jersey Society are pioneers in the plan, it is understood that the Ministry would be prepared to look favourably upon similar proposals from other breed societies. With that object in view the National Cattle Breeders' Association has been put in possession of the scheme. It is expected that this relaxation of restriction will be to the advantage of many farmers, who have cattle of other breeds as well as Jerseys yet who cannot afford to keep a good bull while wishing to keep their herd pure.

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Lord Bledisloe, speaking at a Gloucester meeting, warned men from the Forces not to sink their gratuities in pig or poultry farms and expect to make a livelihood unless they connected such farms to some other activities.

NOTES AND NEWS

Diary of Events

Feb. 26th.—Meeting of the Dumfries and Galloway Division, N.V.M.A., at Dumfries (Station Hotel), 2.30 p.m.

Feb. 26th and 27th.—Meetings of the British Society of Animal Production, Queen Mary Hall, Y.W.C.A. Central Club, Great Russell Street, W.C.1, 10.30 a.m.

Feb. 27th.—Meeting of the Scottish Metropolitan Division, N.V.M.A., at Edinburgh ("Dick" College), 2.30 p.m.

Feb. 28th.—Annual General Meeting of the Lancashire Division, N.V.M.A., at Manchester (Grand Hotel), Aytoun Street), 2.30 p.m.

Feb. 28th.—Meeting of the Ayrshire Division, N.V.M.A., at Ayr (Kirkhill), 2.30 p.m.

Mar. 1st.—Annual General Meeting of the South Wales Division, N.V.M.A., at Carmarthen (Dolwar Café), 2.15 p.m.

Mar. 2nd.—Whole-day Conference of the Nutrition Society (English Group), at the London School of Hygiene, Keppel Street, W.C.1.

Mar. 2nd.—Whole-day meeting of the Nutrition Society (Scottish Group) at the Institute of Hygiene, the University, Glasgow.

Mar. 2nd.—Meeting of the Society of Women Veterinary Surgeons at Birmingham (Grand Hotel), 2.30 p.m.

Mar. 6th.—Meeting of the West of Scotland Division, N.V.M.A., at Glasgow (North British Hotel), 2.30 p.m.

Mar. 7th.—Meeting of the Central Veterinary Society at the Conway Hall, Red Lion Square, W.C.1, 2 p.m.

Mar. 8th.—Meeting of the N.V.M.A. Overseas Committee, 10.30 a.m.

Mar. 12th.—Joint Meeting of the Zoological Society of London and the Institute for the Study of Animal Behaviour, Zoological Gardens, London, 5 p.m.

Mar. 14th.—N.V.M.A. Survey Committee, 36, Gordon Square, W.C.1, 10.30 a.m.

Mar. 15th.—N.V.M.A. Survey Committee, 36, Gordon Square, W.C.1, 10 a.m.; N.V.M.A. Drafting Committee on Calf Husbandry and Calf Diseases, 2 p.m.

N.V.M.A. Meetings at 36, Gordon Square:—

Apr. 15th.—Therapeutic Trials Committee at 11.30 a.m.
Finance and General Purposes Committee at 1.30 p.m.

Apr. 16th.—Sub-committee on First Aid Handbook at 10 a.m.
Organizing Committee at 12 noon.
Joint Veterinary Officers and Public Health and Parliamentary Committee at 2 p.m.
Sub-committee on Conditions of Sale at Cattle Markets at 2.30 p.m.
Appointments Committee at 4 p.m.

N.V.M.A. Meeting at the Connaught Rooms, Great Queen Street:—

Apr. 17th.—Council Meeting at 11 a.m.

May 3rd.—Meeting of the Welsh Branch, N.V.M.A., at Aberystwyth.

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PERSONAL

Appointment of Chief Veterinary Officer to the Corporation of Birmingham

Mr. Cecil Gordon Allen, M.R.C.V.S., D.V.S.M., who has been Chief Assistant Veterinary Officer for the past 22 years, has been appointed Chief Veterinary Officer for Birmingham, as from April 1st, 1946, to succeed Mr. Brennan DeVine, who, as announced in our last issue, is retiring. Mr. DeVine is going to live at White Cross, Zeals, Wiltshire.

Birth.—Twizell.—At Heathfield, Barnborough, on February 11th, 1946, to Elizabeth (Raitt), wife of C. W. Twizell, M.R.C.V.S., Cranmore, Hooton, Wirral—a daughter.

Marriage.—Shuja—Tipler.—On February 15th, 1946, in Birmingham, Jalal Shuja, M.R.C.V.S., younger son of the late Sheikh Jalal-ud-Din and of Begum Sheikh Jalal-ud-Din, of 17/19, The Mall, Delhi, to Mary Tipler, younger daughter of Mr. and Mrs. F. H. Tipler, of "Ashcroft," Tanworth-in-Arden, Warwickshire.

R.C.V.S. Fellowship for Dr. O. V. Gunning.—At the January quarterly meeting of Council, R.C.V.S., it was resolved that the Diploma of Fellow be conferred on Captain Oscar Vernon Gunning, D.V.M. (Ohio), M.R.C.V.S., of the Limes, Acle, Norwich (formerly of Tutbury, Staffs.). The title of Captain Gunning's Thesis was "Joint-ill in Foals."

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ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Swine Fever:

Dunbartonshire.—Feorlinbreck, Garelochhead, Helensburgh, Dunbartonshire (Feb. 13th).

Hants.—" Hillcrest," Winchester Road, Four Marks, Alton, Hants. (Feb. 12th).

Herts.—Bridgewater Farm, Little Gaddesden, Berkhamstead, Herts. (Feb. 14th).

Hunts.—Wakes Farm, Farcet Fen, Peterborough, Northants. (Feb. 13th).

Isle of Wight.—Freshwater Farm, Freshwater, Isle of Wight (Feb. 13th).

Leics.—Tomlinson's Buildings, Harby, Melton Mowbray, Leics. (Feb. 12th).

Lincs. (Kesteven).—The Mill Farm, Gunby, Grantham, Lincs. (Feb. 15th).

Lincs. (Lindsey).—Ivy House Farm, Lusby, Spilsby, Lincs. (Feb. 14th).

Norfolk.—Field Premises, Highgate, King's Lynn, Norfolk (Feb. 16th); Summer Lane, Rickinghall Imferior, Diss, Norfolk (Feb. 18th).

Notts.—Grange Farm, Gamston, Retford, Notts. (Feb. 16th).

Oxfordshire.—Forest Lodge Farm, Headington, Oxford (Feb. 16th).

Soke of Peterborough.—Hodney Farm, Hodney Bridge, Eye, Peterborough, Northants. (Feb. 15th); Wellington Street, Peterborough, Northants. (Feb. 18th).

Suffolk, East.—97, The Common, Mellis, Eye, Suffolk (Feb. 16th).

Wiltshire.—The Piggeries, Marlborough Road, Wootton Bassett, Swindon, Wilts. (Feb. 12th).

Yorks., E.R.—Dringhoe Grange, Skipsea, Driffield, Yorks. (Feb. 15th); George and Dragon Hotel, North Dalton, Driffield, Yorks. (Feb. 16th).

Yorks., W.R.—Woodhouse Farm, Bossall, York (Feb. 16th).

Sheep Scab:

Westmorland.—Whitby Steads, Askham, Penrith, Cumberland (Feb. 14th).

Yorks., W.R.—Manor House Farm, Stanbury, Keighley, Yorkshire (Feb. 15th).

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MINISTRY OF AGRICULTURE NEWS SERVICE

Mechanization of Milk Production

Conference at Winchester.—The three days' conference on the "Mechanization of Milk Production" recently held by the Hampshire Agricultural Executive Committee, and opened by the Earl of Huntingdon, Joint Parliamentary Secretary to the Ministry of Agriculture and Fisheries, proved to be one of the most popular meetings ever organized by the committee. Each day the Guildhall at Winchester was packed to capacity.

In comparison with some counties, Hampshire is a relative newcomer to milk production, for it is only during the past 40 to 50 years that it has changed over from arable sheep and corn growing to milk production and stock raising. This change over brought difficulties regarding buildings, fences and water supplies, some of which are still problems. The first paper of the conference, "Farm Buildings and Milk Production," read by Mr. P. J. Moss, Ministry of Agriculture and Fisheries, in the place of Sir Frank Engledow, was listened to with great attention and led to a lengthy discussion that was opened by Lord Portsmouth, Vice-Chairman, Central Landowners' Association. During the discussion reference was made to the cooling of milk by the churn-immersion method as practised in America. Lord Portsmouth said that at the moment we were faced of necessity with very indifferent farm buildings, and even if it were financially possible to erect new ones, labour and materials were limited. In the next four to five years it was reasonable to expect that farmers may be fairly prosperous and these years may well be used in the improvisation of a great many of our present buildings.

Mr. C. A. Cameron Brown's paper on "The Application of Electric Power in the Dairy and Farm Buildings" gave detailed information in the way this form of power could be economically used. Mr. H. Ebdon, Milk Marketing Board, in a paper "What the Producer Needs," also made reference to the potential uses to which electricity could be put to lighten the labour and improve the general conditions of production on dairy farms. He drew attention to the need for the fullest development of rural electrification as a social as well as an industrial measure.

Altogether eleven papers were read, dealing with every aspect of milk production including grass and fodder crop drying and mechanization of fodder crop production and harvesting on the dairy farm.

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BULL LICENSING

The Minister of Agriculture and Fisheries has amended the regulations governing the licensing of bulls so as to remove the limitation that Dairy Bull Licences can only be granted for bulls whose dams and sires' dams have been milk-recorded under approved schemes operating in England and Wales. In future, milk records attained under the auspices of the Scottish Milk Records Association in Scotland or of the Minister of Agriculture for the Dominion of Canada will also be accepted as evidence that the minimum milk yields necessary for a Dairy Bull Licence have been achieved. The minimum quantities remain as formerly at 600 gallons with the first calf or 700 gallons with the second calf or 800 gallons with an subsequent calf in a lactation period of not more than 365 days.

Any bull owner who was granted a General Class Licence because the milk yields of the dam or sire's dam of his bull, although above the minimum requirements, were officially recorded in Scotland or Canada may now apply to the Ministry of Agriculture for a transfer to the Dairy Class. This will be arranged without charge where the necessary evidence of milk production is forthcoming.

The possible recognition of milk records achieved in other countries from which dairy cattle are or have been imported is still under consideration.

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WORLD RECORD PRICE FOR PEDIGREE BULL

A world record price for a pedigree cattle beast of any breed was paid at the recent sale of pure-bred Shorthorns at Perth. The supreme champion, Pittodrie Upright, belonging to Mr. R. Laidlaw Smith, of Pitcaple, Aberdeenshire, was sold for 14,500 guineas to Mr. Ralph L. Smith, of Missouri, United States. Bidding started at 1,000 guineas and rose by 1,000-guinea bids to 13,000 guineas, and from that point by 500 guineas until the record price was reached.

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ROYAL COLLEGE OF SURGEONS' LIBRARY REOPENED

The main library of the Royal College of Surgeons was not seriously damaged when other parts of the building were bombed, and the books have now been returned to the shelves. Several tons of books had been evacuated to Downton Castle, Ludlow, Alfrick Court, Worcester, and the National Library of Wales. Rearrangement of the library is now proceeding, and the reading room is open once more to students from all parts of the world.

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H.M. STATIONERY OFFICE PUBLICATIONS

The undermentioned have been publisher recently. Copies can be purchased through any bookseller, or directly from H.M. Stationery Office.

	Price	*Post*
House of Commons Papers (Session 1945-46):		
57. Agriculture (Artificial Insemination) Bill. Standing Committee C. Minutes of Proceedings	0 1	0 2
Health, Department of, for Scotland:		
Memorandum No. 9. Scottish Milk Testing Scheme. Jan., 1946	0 2	0 3
Draft Statutory Rules and Orders, 1946:		
Therapeutic Substances Amendment Regulations. (Published Feb. 4, 1946)	0 1	0 2

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RESTORATION OF THE HUNTERIAN COLLECTION

Sir Alfred Webb-Johnson, presiding at the Hunterian dinner of the Royal College of Surgeons at Lincolns Inn on February 14th, announced that Sir William Collins had made a further gift of £100,000 to the college on certain conditions. He said that progress was being made with the plans for restoration of the Hunterian Museum and they had received help and encouragement from all parts of the world. The Bernhard Baron Trustees provided an endowment for experimental research so that in their preoccupations with more material concerns this work should go on without interruption. It was decided that the museum needed men to take charge of the two sections, anatomy and pathology, and they were fortunate to secure the services of Professor Willis, from Melbourne, and Professor Wood Jones, from Manchester. Sir William Collins encouraged them to buy the sites and also provided endowments of £200,000 for the scientific departments.

In providing the means for carrying out their plans, the response of the Fellows of the college had been inspiring at home and abroad, and from the profession support had come from all quarters. The plans provided for enlarged museum space, extensions of research rooms, rooms for separate study, and common rooms for postgraduates from all parts of the world, extensions of the library, and a great conference hall. The Wellcome Trustees made a magnificent gift, and they valued equally with the gift their collaboration and the help of Sir Henry Dale so that they could establish in London a group of medical museums that would be a Mecca for students from all countries. Thus they carried on the great Hunterian tradition.

There was loud cheering when the President announced the further £100,000 gift by Sir William Collins and expressed thanks for his generosity.

In a message sent to the King the President wrote expressing deep appreciation of his Majesty's constant interest and encouragement as a visitor of the college, adding: "Representatives of the Commonwealth and Empire are also present, as well as the Ambas-

sadors of many countries which have promised to help in the restoration of the unique museum which was one of the nation's most valued possessions. The Council is happy to inform your Majesty that, thanks to the generous support of scientists in all parts of the world, good progress is being made in the heavy task which lies before them."

The King replied: "Please convey to the members of the Council and Court of Examiners of the Royal College, and to the Trustees of the Hunterian Collection, my sincere thanks for their kind message.

"As Visitor of the college I am very glad to hear that the anniversary of John Hunter's birth is once more being observed in the customary manner, and that such generous help towards the restoration of the Hunterian Museum has been forthcoming from your fellow-workers in so many countries."

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Mr. Alec Hobson, Secretary of the National Pig Breeders' Association, has been appointed Secretary of the Royal Agricultural Society of England in succession to Mr. T. B. Turner, who retires from the position in the spring. Mr. Hobson, who is in his 47th year, has been Secretary of the N.P.B.A. since 1919. The success of the Small Pig Keepers' Council during the war has been in no small measure due to his efforts.

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The Minister of Agriculture and Fisheries proposes to recognise for grant salary scales for the agricultural teaching staffs of local education authorities similar to the Burnham scales for technical schools.

CORRESPONDENCE

The views expressed in letters addressed to the Editor represent the personal views of the writer only and must not be taken as expressing the opinion or having received the approval of the N.V.M.A.

Letters to the Editor should reach the Office not later than by the first post on Monday morning for insertion in following Saturday's issue.

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R.C.V.S. CENTENARY COMMEMORATION NUMBER

From Professor Leclainche.

Monsieur et cher Collègue,—C'est un vieux journaliste et aussi un historien de notre médecine qui vous apporte ses cordiales félicitations pour la magnifique édition du "Centenary Commemoration number" du Royal Collège.

La magistrale évocation du lointain passé de notre art est une heureuse préface à l'histoire si intéressante de notre profession dans votre pays, illustrée par les grandes figures de ses maîtres.

Des voies nouvelles nous sont ouvertes en ce moment et nous devons choisir entre elles. De ce choix dépend tout notre avenir. Le *Record* s'est placé à la tête des journaux vétérinaires du monde entier. Il a réussi pleinement dans sa mission d'information; il lui incombe maintenant de s'associer aux efforts de ceux qui préparent, dans le cadre des sociétés nouvelles, la rénovation de nos concepts et de nos activités.

Je souhaite au *Record* un avenir digne de son glorieux passé et je prie son éditeur d'agréer l'hommage de ma haute considération et de mon fidèle attachement.

E. Leclainche.

Office International des Epizooties,
12, Rue de Prony, Paris (XVIIe).
le 24 Janvier, 1946.

Translation

Sir and dear Colleague,—As an old journalist as well as an historian of our profession I tender my hearty congratulations to you upon the magnificent issue of the "Centenary Commemoration Number" of the Royal College of Veterinary Surgeons.

The masterly recapitulation of the origins of our art forms a graceful preface to the very interesting history of our profession in your country, adorned as it is by the great figures of its outstanding exponents.

Fresh avenues are opening up before us at this moment and we have to make our choice among them. Our entire future depends upon the way we make our choice. The *Record* has taken a leading place among the veterinary periodicals of the whole world. It has fulfilled with complete success its mission to distribute information; it is incumbent upon it now to associate itself with the efforts of those who are engaged within the ambit of new societies in a remodelling of our ideas and of our activities.

I wish the *Record* a future worthy of its glorious past, and respectfully beg its editor to accept this testimony of my high esteem and deep regard.

E. Leclainche.

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ABNORMALLY LARGE CALVES

Sir,—I was interested to read Mr. F. B. Edwards' letter this week describing delivery of an abnormally large Friesian calf. I had *two* similar cases last year—the first, from a cross-bred Friesian cow, weighed 125 lb., and the second, from a Friesian cow, weighed 166 lb.

Yours faithfully,

The Cedars, Preston Road, J. D. Hall.
Yeovil, Somerset.
February 16th, 1946.

Sir,—As abnormally large calves go, Mr. F. B. Edwards' 118 lb. Friesian is rather on the small side, and much larger calves have been recorded on many occasions in the veterinary and agricultural press.

In *The Veterinary Record* for January 10th, 1920, I described, as a student, a Shorthorn calf, which was born alive and weighed 140 lb.

In the following week's *Record* the late Mr. C. A. Powell, of Woburn, Beds., gave particulars of a calf, also a Shorthorn, which he delivered and which weighed 160 lb. He also mentioned having delivered a cow of twins, the combined weight of the calves being in the region of 190 lb.

Yours faithfully,

Hallaton, Market Harborough. Geo. Eaton.
February 18th, 1946.

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VETERINARY EDUCATION

Sir,—Mr. Burrow's attack, in your issue of January 19th, on all "dissatisfied grumblers" and Major Bain in particular, seems unreasonably severe. Major Bain expressed no dissatisfaction with unscientific language used at an N.V.M.A. divisional meeting, but with the unscientific mode of presentation, a very different matter. As regards the learned Major's professional ability and keenness to progress, I should like to say that much of his early work in the R.A.V.C. was carried out at a base veterinary hospital in the Middle East at a time when the dressing and operating staffs were dominated by a group of veterinary students. It would be difficult to imagine a more critical body, but all rated him high among the V.O.'s under whom we worked.

To talk of relinquishing a profession rather than trying to improve it would appear a trifle short-sighted, and it is rather frightening for students to contemplate facing such extreme conservatism. Should one, on such grounds, change one's nationality rather than advocate social reform? No profession can have sufficient of the men who have such pride in it as Mr. Burrow, but surely it is that very pride and interest which leads to an expression of dissatisfaction when one sees work which can and should be done by the veterinary profession, being done by others. And to say that there is nothing in veterinary education which will bear readjustment is unreasonable. It would give greater encouragement to undergraduates to know that more members of the profession took an active interest in our education.

Yours faithfully,

A. Montefiore
Royal Veterinary College, (Student, late R.A.V.C.)
Royal College Street,
Camden Town, N.W.1.
January 20th, 1946.

DISEASES OF ANIMALS ACTS, 1894 TO 1937, AND AGRICULTURE ACT, 1937 (PART IV).

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period	Anthrax	Foot-and-mouth	Parasitic Mange•	Sheep Scab	Swine Fever
Jan. 16th to 31st, 1946 ...	6	9	2	6	29
Corresponding period in—					
1945 ...	4	15	—	1	41
1944 ...	12	2	2	12	27
1943 ...	14	1	—	19	28
Total Jan. 1st to Jan. 31st, 1946 ...	15	13	3	9	48
Corresponding period in—					
1945 ...	13	23	1	8	87
1944 ...	24	3	3	34	48
1943 ...	28	8	—	28	41

Note.—The figures for the current year are approximate only.
• Excluding outbreaks in Army Horses.

Tuberculosis (Attested Herds) Schemes

The number of Attested Herds, *i.e.*, herds officially certified as free from Tuberculosis as at January 31st, 1946, was as follows:—

England	Wales	Scotland	Total (Great Britain)
5,377	9,258	5,681	20,316